

Welcome to iCHSTM 2013

On behalf of the British Society for the History of Science, I would like to welcome you all to the 24th International Congress of the History of Science, Technology and Medicine. The BSHS is proud to host the International Congress, in the United Kingdom for the third time, with support and encouragement from many other UK-based bodies. We have all appreciated this opportunity to contribute to the global development of our subject. The 2013 meeting promises to be the largest ever, with quality to match. Manchester is a very appropriate place for our meeting, with its rich and unique traditions of science, technology and medicine. Our colleagues on the Local Organising Committee have truly put their hearts and souls, as well as countless hours of work, into the preparation of this event, and I think you will be able to see evidence of the care and trouble they have taken. I hope your week at the Congress will be filled with stimulating discussions and congenial interactions with colleagues from many corners of the world.



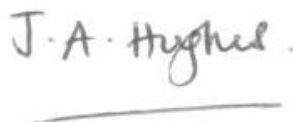
Hasok Chang

President

British Society for the History of Science

Welcome to Manchester

On behalf the Local Organising Committee for iCHSTM2013, it is a pleasure and a privilege to welcome iCHSTM delegates to the City and University of Manchester. For this exceptionally large meeting, we have tried to provide a wide variety of intellectual and social activities. With up to 24 parallel tracks, the academic programme is the heart of iCHSTM, and we hope it will stimulate lively discussion and debate both within and about our field. But iCHSTM also offers an extensive formal and informal social programme, from official receptions to HSTM-related music and comedy, and a wide range of HSTM-themed walks, tours and visits. And iCHSTM will actively use social media to promote our field to the wider world. We hope that iCHSTM2013 will be a Congress to remember, and that you enjoy your time in Manchester!



Jeff Hughes and James Sumner

Co-chairs

iCHSTM Local Organising Committee

About the programme

The first section of this programme consists of a day-by-day summary of the programme content, including session titles and details of other events.

The second and largest section presents a complete description of the sessions, including abstracts. This section begins with all the symposia and standard paper sessions (codes beginning P, Q, S, T, W) **in numerical order**, without reference to the letter code. There then follow sections for plenaries, special and lunchtime sessions, social and public events, and committee meetings. Walks, tours and excursions are listed in the daily summaries but are not described in detail in this programme: see the website or ask at the Congress Events Desk for full details.

The final section lists the participants alphabetically, with contact information and listings of the sessions in which they are involved.

The letters prefixing the event codes have the following meanings:

A: plenary events

C: committee meetings

E: special sessions (discussion events, talks and film screenings)

F: lunchtime advice sessions aimed at graduate students and early-career researchers

J: formal social programme (receptions and Congress Dinner)

K: 'fringe', informal social programme (music and comedy)

L: public events

M: walks and tours on the University campus

P: organised symposia accepted by ICOHTEC

Q: sessions compiled from stand-alone papers accepted by ICOHTEC

R: other receptions

S: organised symposia accepted by the central Congress organisers

T: sessions compiled from stand-alone papers accepted by the central Congress organisers

W: sessions compiled from stand-alone papers accepted by the Scientific Instrument Commission

Room locations are given with the building name first, followed by the room number. The lecture theatres in the Schuster Building are not numbered, but take their names from Manchester physicists: 'Schuster Rutherford' refers to the Schuster Building's Rutherford Lecture Theatre, etc.

Information about facilities on and around the site, along with site maps, is provided in the short **summary programme** distributed to all attendees. For further information, including a full clickable version of the programme, see the website at www.ichstm2013.com

Day-by-day listing

SUNDAY 21 July

Committee meeting

DHST Council Meeting (C271)

15:00–17:30, Room 2.57, Simon Building

Social programme

Welcome reception (J321)

18:00–20:00, Manchester Museum

MONDAY 22 July, early morning

Plenary

Congress opening ceremony and keynote (A391)

08:45–10:30, University Place LT A and B

Excursions, off-site tours and visits

Jodrell Bank Observatory excursion (Monday) (X221)

09:15–13:00

late morning and lunchtime ▪ 22 July MONDAY

11:00–12:30

S025-A **University Place 2.218**
Headwinds through the Iron Curtain: fundamental and applied sciences in Communist Eastern Europe

S045-A **Roscoe 1.007**
Mathematical facets of measurement, measuring units, measured quantities and their uses ▪ How did actors compute with measured numbers? Part 1

S072-A **University Place 1.218**
Preserving scientific heritage to enable working with knowledge: how historians, archivists and scientists can engage in preserving and disseminating scientific heritage via a global online system

S075-A **University Place 3.204**
Publishing the sciences ▪ Scientific intelligence and expertise

S084-A **Roscoe 2.4**
Social science, ideology, and public policy in the United States, 1961 to 2011

S092-A **Schuster Blackett**
Astronomy and its applications in ancient and medieval societies ▪ Astronomy and its cultural role in the ancient Near East

S099-A **Roscoe 2.2**
History of metrology: a view of comparison between the West and the East ▪ Ancient metrology

S114-A **Roscoe 1.009**
Mathematics and patronage ▪ Eighteenth and nineteenth centuries

T159-A **University Place 4.204**
Place and affect in early-modern sciences ▪ Early modern

T167-A **University Place 4.206**
Working worlds of the twentieth-century biological sciences ▪ Pure and applied life sciences

11:10–12:40

S017 **University Place 3.205**
Boundaries at work: producing experimental and clinical knowledge of/with epilepsy between neurology, psychiatry and neuroscience in the nineteenth and twentieth centuries

S058-A **University Place 1.219**
Working in science and as art: twentieth-century 'experimental' relationships ▪ Demonstrating natures

S062-A **Roscoe 2.3**
Reworking the history of chemistry: practice, revolution, visualization and exchange ▪ Practice: recovering early alchemy and chemistry

S091-A **Roscoe 2.5**
The achievements of R J Boscovich in the philosophy of nature, astronomy, technique and culture: historical resources and contemporary epistemic reflections ▪ Boscovich's achievements in the philosophy of nature and modern science

S105-A **Schuster Moseley**
One hundred years of the Bohr atom ▪ Foundations

S108-A **Roscoe 1.010**
Knowledge at work in the oceans of the world ▪ Observers and instruments

T163-A **Roscoe 1.008**
Mapping, geography and geology ▪ The politics of mapping

T181-A **University Place 4.205**
Cultures of eighteenth- and nineteenth-century science and engineering ▪ Cultures of knowledge and practice

Special session

40th anniversary symposium: the history of ICOHTEC ▪ Get socialised: ICOHTEC in the big picture (E118-A)
11:10–12:40, Schuster Bragg

Committee meeting

Science and Empire Commission business meeting (C268)
11:00–13:00, University Place 4.212

Lunchtime sessions

Why blog? An introduction (F303)
13:00–13:45, University Place 4.205

Graduate students' guide to Manchester (F311)
13:00–13:45, University Place 4.204

Walks and tours around the Congress site

Manchester Museum tour (M351)
12:00–13:00, Manchester Museum

Campus history walk: physics (M240)
13:00–13:45, Walk starts outside the main entrance to the Manchester Museum

A short walk about Turing (M384)
13:00–13:45, Walk starts outside the main entrance to the Manchester Museum

Manchester Museum tour (M352)
13:00–14:00, Manchester Museum

MONDAY 22 July ▪ early afternoon

14:00–15:30

S025-B **University Place 2.218**
Headwinds through the Iron Curtain: fundamental and applied sciences in Communist Eastern Europe

S045-B **Roscoe 1.007**
Mathematical facets of measurement, measuring units, measured quantities and their uses ▪ How did actors compute with measured numbers? Part 2

S072-B **University Place 1.218**
Preserving scientific heritage to enable working with knowledge: how historians, archivists and scientists can engage in preserving and disseminating scientific heritage via a global online system ▪ Sharing knowledge in context: linked data and online technologies in scientific archives

S075-B **University Place 3.204**
Publishing the sciences ▪ Periodicals and popularisation

S084-B **Roscoe 2.4**
Social science, ideology, and public policy in the United States, 1961 to 2011

S092-B **Schuster Blackett**
Astronomy and its applications in ancient and medieval societies ▪ Instruments and inscriptions in Greco-Roman astronomy

S099-B **Roscoe 2.2**
History of metrology: a view of comparison between the West and the East ▪ Metrology and standardization

S114-B **Roscoe 1.009**
Mathematics and patronage ▪ Nineteenth and twentieth centuries

T159-B **University Place 4.204**
Place and affect in early-modern sciences ▪ Spaces and practical knowledge

T167-B **University Place 4.206**
Working worlds of the twentieth-century biological sciences ▪ Eugenics

14:10–15:40

S026-A **University Place 3.205**
Pratiques et théories dans le champ de la santé mentale: quel(s) rapport(s)?

S058-B **University Place 1.219**
Working in science and as art: twentieth-century 'experimental' relationships ▪ Demonstrating technologies

S062-B **Roscoe 2.3**
Reworking the history of chemistry: practice, revolution, visualization and exchange ▪ Visualising: the matter of form in modern chemistry

S086-A **University Place 2.219**
Data at work ▪ Biology, agriculture and medicine

S091-B **Roscoe 2.5**
The achievements of R J Boscovich in the philosophy of nature, astronomy, technique and culture: historical resources and contemporary epistemic reflections ▪ Boscovich's heritage in the European context

S105-B **Schuster Moseley**
One hundred years of the Bohr atom ▪ Elucidations

S108-B **Roscoe 1.010**
Knowledge at work in the oceans of the world ▪ Expeditions

T163-B **Roscoe 1.008**
Mapping, geography and geology ▪ Geological travels

T181-B **University Place 4.205**
Cultures of eighteenth- and nineteenth-century science and engineering ▪ The machine

Special session

40th anniversary symposium: the history of ICOHTEC ▪ From hardware to software: changes in the ICOHTEC research agenda (E118-B)

14:10–15:40, Schuster Bragg

late afternoon and evening ▪ MONDAY 22 July

16:00–17:30

S025-C **University Place 2.218**
Headwinds through the Iron Curtain: fundamental and applied sciences in Communist Eastern Europe

S045-C **Roscoe 1.007**
Mathematical facets of measurement, measuring units, measured quantities and their uses ▪ How did actors use and discuss measuring units?

S072-C **University Place 1.218**
Preserving scientific heritage to enable working with knowledge: how historians, archivists and scientists can engage in preserving and disseminating scientific heritage via a global online system

S075-C **University Place 3.204**
Publishing the sciences ▪ Why publish?

S084-C **Roscoe 2.4**
Social science, ideology, and public policy in the United States, 1961 to 2011

S092-C **Schuster Blackett**
Astronomy and its applications in ancient and medieval societies ▪ European medieval astronomy and astrology

S099-C **Roscoe 2.2**
History of metrology: a view of comparison between the West and the East ▪ The modernization of metrology

S114-C **Roscoe 1.009**
Mathematics and patronage ▪ Twentieth century

T159-C **University Place 4.204**
Place and affect in early-modern sciences

16:10–17:40

S026-B **University Place 3.205**
Pratiques et théories dans le champ de la santé mentale: quel(s) rapport(s)?

S062-C **Roscoe 2.3**
Reworking the history of chemistry: practice, revolution, visualization and exchange ▪ Exchange: global histories of chemistry

S067 **Roscoe 1.008**
Corps, santé, médecine et maladies en milieu de travail en Amérique latine, 19e et 20e siècles

S086-B **University Place 2.219**
Data at work ▪ Making coding cultures

S105-C **Schuster Moseley**
One hundred years of the Bohr atom ▪ Ramifications

S108-C **Roscoe 1.010**
Knowledge at work in the oceans of the world ▪ On the interpretation of in-situ data

T181-C **University Place 4.205**
Cultures of eighteenth- and nineteenth-century science and engineering ▪ Eighteenth- and nineteenth-century science and engineering

Special sessions

Discussion: social media, public engagement and the history of science, technology and medicine (E302)
16:00–17:40, University Place 1.219

40th anniversary symposium: the history of ICOHTEC ▪ Long-term ICOHTEC research themes (E118-C)
16:10–17:40, Schuster Bragg

Walks and tours around the Congress site

Campus history walk (M241)
17:45–18:30, Walk starts outside the main entrance to the Manchester Museum

Social programme

UK learned societies' reception (J322)
18:00–19:30, University Place Drum

Music: The Noisy Frame. Lives of clothmakers in song and testimony, 1780-1840 (K331)
21:00–22:30, Jabez Clegg

Other receptions

ICOHTEC anniversary reception (R326)
17:45–18:45, Schuster Foyer

iCHSTM tweetup (R338)
18:00–19:30, Ducie Arms

Public event

The Turing Machine Opera, with Decode/Recode (Monday performance) (L346)
18:15–20:00, Capitol Theatre

TUESDAY 23 July ▪ early morning

09:00–10:30

- S011-A** **University Place 4.213**
Les sciences mathématiques 1750-1850: continuités et ruptures
- S020-A** **University Place 4.204**
Plant science and global food security in the twentieth century
- S051-A** **Roscoe 1.007**
Population control and reproductive health rights in Cold War Asia ▪ East Asia
- S087-A** **Roscoe 1.009**
Science and the emotions: transnational and interdisciplinary perspectives
- S092-D** **Schuster Blackett**
Astronomy and its applications in ancient and medieval societies ▪ Astronomy and its applications in western Asia and the Islamic world
- S112-A** **University Place 1.218**
Geology in art and literature ▪ The geological imagination
- S115-A** **Roscoe 2.4**
Mathematical knowledge at work in Ancient China
- P125** **University Place 4.206**
Enforced specialization in computing technology: debugging the history of cooperation and competition in COMECON countries
- W131-A** **Schuster Rutherford**
32nd Scientific Instrument Symposium ▪ Trade and transfer of scientific instruments, part 1
- T165-A** **University Place 3.204**
Contexts of natural history ▪ Botany books and careers in the eighteenth and nineteenth centuries
- T193-A** **University Place 2.218**
Science, technology and medicine in the public sphere ▪ Science, technology and medicine in the public sphere

09:10–10:40

- S002-A** **University Place 1.219**
Research in science museums: the state of the art ▪ Museum-university collaborations: an ideal marriage?
- S033-A** **University Place 4.212**
Paris: capital of hygiene? ▪ Food, fitness, and fatality: hygiene and bodies
- S046-A** **Roscoe 1.008**
Visual communication in early-modern to modern learned journals
- S053-A** **Roscoe 2.3**
Knowledge at work across cultural boundaries
- S074-A** **University Place 4.205**
Connected histories? Science and technology from a new historiographical perspective
- S079-A** **University Place 3.205**
Materia medica and pharmacy: from the medicinal virtues to the active principles of plants
- S106-A** **Roscoe 2.5**
Philosophy at work in modern physics
- T182-A** **University Place 2.219**
Post-Second World War science and technology ▪ Postwar contexts
- S199-A** **Roscoe 1.010**
Science, technology and medicine in the Ottoman Empire

Committee meetings

Oceanography Commission business meeting (C260)
09:10–10:40, University Place 4.214

Excursions, off-site tours and visits

Jodrell Bank Observatory excursion (Tuesday) (X222)
09:15–13:00

late morning and lunchtime ▪ 23 July TUESDAY

11:00–12:30

- S011-B** **University Place 4.213**
Les sciences mathématiques 1750-1850: continuités et ruptures
- S019** **University Place 4.206**
Aspects of the history of radio communications: how radio has transformed the world, and exploration, since the days of David Livingstone (1813-1873)
- S020-B** **University Place 4.204**
Plant science and global food security in the twentieth century
- S051-B** **Roscoe 1.007**
Population control and reproductive health rights in Cold War Asia ▪ South Asia
- S087-B** **Roscoe 1.009**
Science and the emotions: transnational and interdisciplinary perspectives
- S092-E** **Schuster Blackett**
Astronomy and its applications in ancient and medieval societies ▪ South and East Asian astronomy, part 1
- S100-A** **Roscoe 2.2**
Comparative perspectives on ancient astronomy: the Chinese and Greek traditions ▪ Chinese calendar-making
- S112-B** **University Place 1.218**
Geology in art and literature ▪ Geology between Enlightenment and Romanticism
- S115-B** **Roscoe 2.4**
Mathematical knowledge at work in Ancient China
- W131-B** **Schuster Rutherford**
32nd Scientific Instrument Symposium ▪ Trade and transfer of scientific instruments, part 2
- T165-B** **University Place 3.204**
Contexts of natural history ▪ Spaces and places of natural history
- T193-B** **University Place 2.218**
Science, technology and medicine in the public sphere ▪ Science and religion in local contexts

Special session

Victorian science spectacular (E308)
11:00–12:30, Pear Lecture Theatre, Coupland 1 Building

Lunchtime sessions

Graduate students' guide to Manchester (F312)
13:00–13:45, University Place 4.204

Careers and funding: academia, museums, and public institutions (F317)
13:00–13:45, University Place 4.205

Walks and tours around the Congress site

Manchester Museum tour (M355)

11:10–12:40

- S002-B** **University Place 1.219**
Research in science museums: the state of the art ▪ Artefacts and beyond: multiple perspectives on material culture research
- S033-B** **University Place 4.212**
Paris: capital of hygiene? ▪ Administering the hygienic city: regulation and reform
- S046-B** **Roscoe 1.008**
Visual communication in early-modern to modern learned journals
- S053-B** **Roscoe 2.3**
Knowledge at work across cultural boundaries
- S074-B** **University Place 4.205**
Connected histories? Science and technology from a new historiographical perspective
- S079-B** **University Place 3.205**
Materia medica and pharmacy: from the medicinal virtues to the active principles of plants
- S106-B** **Roscoe 2.5**
Philosophy at work in modern physics
- P123-A** **Schuster Bragg**
The invisible bicycle: new insights into bicycle history ▪ Patterns of growth and decline
- T182-B** **University Place 2.219**
Post-Second World War science and technology ▪ Organisations
- S199-B** **Roscoe 1.010**
Science, technology and medicine in the Ottoman Empire

Excursions, off-site tours and visits

Ordsall Hall Gardens tour (X353)
11:00–12:00, Ordsall Hall

Cottonopolis walk (X389)
11:00–13:00, Walk starts outside Visitor Information Centre, Piccadilly Gardens

12:00–13:00, Manchester Museum

Manchester Museum herbarium tour (M357)
12:00–13:00, Manchester Museum

Campus history walk: chemistry (M242)
13:00–13:45, Walk starts outside the main entrance to the Manchester Museum

Manchester Museum tour (M356)
13:00–14:00, Manchester Museum

Committee meetings

Modern Physics Commission business meeting (C264)
12:45–13:45, Roscoe 2.5

Tyndall Correspondence Project meeting (C276)
12:45–13:45, University Place 3.205

TUESDAY 23 July ▪ early afternoon

14:00–15:30

S016-A Roscoe 1.007
Image-making and knowledge-making in early-modern Europe ▪ Images at work

S037-A University Place 4.206
Cornucopia or Pandora's box: digital working methods, web portals and Virtual Research Environments (VREs) in the history of science and technology

S040-A University Place 4.204
Science in agriculture: interactions of science, agriculture and environment ▪ Remembering Rachel Carson: the Green Revolution and the politics of industrial agriculture

S087-C Roscoe 1.009
Science and the emotions: transnational and interdisciplinary perspectives

S092-F Schuster Blackett
Astronomy and its applications in ancient and medieval societies ▪ South and East Asian astronomy, part 2

S100-B Roscoe 2.2
Comparative perspectives on ancient astronomy: the Chinese and Greek traditions ▪ Greek tradition in various cultures

S112-C University Place 1.218
Geology in art and literature ▪ Geology and nineteenth-century fiction

S115-C Roscoe 2.4
Mathematical knowledge at work in Ancient China

W131-C Schuster Rutherford
32nd Scientific Instrument Symposium ▪ The bigger, the better: physics and astronomy

T155-A University Place 4.213
Early-modern mathematics ▪ Working cultures of early modern-European maths

T165-C University Place 3.204
Contexts of natural history ▪ Local contexts for natural history

T193-C University Place 2.218
Science, technology and medicine in the public sphere ▪ Public cultures of nineteenth-century science

Excursions, off-site tours and visits

John Dalton walk (X388)
13:30–15:30, Walk starts outside Visitor Information Centre, Piccadilly Gardens

Guided walk: Manchester peace and justice trail (X358)
14:00–16:30, Walk starts by the giant pebble on Barbirolli Square outside Bridgewater Hall

Imperial War Museum North tour: 'Saving Lives' (X354)
15:00–15:30, Imperial War Museum North

14:10–15:40

S002-C University Place 1.219
Research in science museums: the state of the art ▪ Using the Web and social media to extend the traditional aims of museums

S027-A University Place 3.205
Cross-cultural transmissions of medical knowledge in premodern Asia

S060-A Roscoe 1.010
The transmission of medical knowledge in the Islamic world

S063-A Roscoe 1.008
The paper world of science in the age of industry and Empire ▪ Communicating through manuscript and print

S065 Roscoe 2.3
Knowledge between transmission and local cultural boundaries: migrating scientists and physicians in the twentieth century

S073-A University Place 4.212
Medical knowledge at the colonial work front: health reports as research tools ▪ Writing knowledge: colonial physicians

S106-C Roscoe 2.5
Philosophy at work in modern physics

T182-C University Place 2.219
Post-Second World War science and technology ▪ The politics of science, technology and medicine in the European context

Special sessions

The future of journals in the history of science, technology, and medicine (E301)
14:10–15:40, University Place 4.214

Manchester in the history of science, technology and medicine ▪ Using campus heritage for public history: some cases and issues (E309-A)
14:10–15:40, University Place 4.205

Committee meetings

IASCUD Executive Committee meeting 1 (C265)
14:00–15:30, Room 2.57, Simon Building

ICOHTEC Executive Committee meeting (C261-A)
14:10–15:40, Schuster Bragg

late afternoon and evening ▪ 23 July TUESDAY

16:00–17:30

S016-B **Roscoe 1.007**
Image-making and knowledge-making in early-modern Europe ▪ Colour matters

S037-B **University Place 4.206**
Cornucopia or Pandora's box: digital working methods, web portals and Virtual Research Environments (VREs) in the history of science and technology

S040-B **University Place 4.204**
Science in agriculture: interactions of science, agriculture and environment ▪ Agricultural science: interactions between agricultural problems and theoretical knowledge

S092-G **Schuster Blackett**
Astronomy and its applications in ancient and medieval societies ▪ South and East Asian astronomy, part 3

S112-D **University Place 1.218**
Geology in art and literature ▪ The art of geological mapping

W131-D **Schuster Rutherford**
32nd Scientific Instrument Symposium ▪ Understanding instruments of physics through re-use and replication

T152 **Roscoe 1.009**
Gender at work

T155-B **University Place 4.213**
Early-modern mathematics ▪ Non-western mathematics in translation and appropriation

T165-D **University Place 3.204**
Contexts of natural history ▪ Animals, monsters, and culture

Walks and tours around the Congress site

Campus history walk (M243)
17:45–18:30, Walk starts outside the main entrance to the Manchester Museum

Committee meetings

ICOHTEC Executive Committee meeting (C261-B)
16:10–17:40, Schuster Bragg

IASCUD General Assembly (C281)
16:10–17:40, University Place 4.214

16:10–17:40

S002-D **University Place 1.219**
Research in science museums: the state of the art ▪ Developing a public history of science, technology and medicine

S027-B **University Place 3.205**
Cross-cultural transmissions of medical knowledge in premodern Asia

S060-B **Roscoe 1.010**
The transmission of medical knowledge in the Islamic world

S063-B **Roscoe 1.008**
The paper world of science in the age of industry and Empire ▪ Newspaper networks

S073-B **University Place 4.212**
Medical knowledge at the colonial work front: health reports as research tools ▪ Writing, counting and accounting for public health: empire, state and nation

S106-D **Roscoe 2.5**
Philosophy at work in modern physics

T182-D **University Place 2.219**
Post-Second World War science and technology ▪ The nuclear Pacific

Special sessions

Manchester in the history of science, technology and medicine ▪ Roundtable discussion: Manchester topics and contexts (E309-B)
16:10–17:40, University Place 4.205

Social programme

Civic reception (J323)
19:00–21:00, Manchester Town Hall

Comedy: XS Malarkey (K332)
20:00–22:30, Jabez Clegg

Public events

Strange ice (L345)
16:00–17:30, Room G51, Chemistry Building

The Turing Machine Opera, with Decode/Recode (Tuesday performance) (L347)
18:15–20:00, Capitol Theatre

Victorian science spectacular (L342)
19:30–21:00, Portico Library

WEDNESDAY 24 July ▪ early morning

09:00–10:30

- S015-A** Roscoe 1.009
Novel expertise and emerging specialists
- S022-A** University Place 4.204
From natural history to ecology: towards a comparative history of life sciences in the long nineteenth century
- S029-A** Roscoe 1.007
Visual, material and empirical culture in early-modern Iberian science: artifacts, regiments, vessels, nautical charts, natural specimens, cosmographers, naturalist and pilots
- S031-A** University Place 4.213
The contribution of Friedrich Engels in the history of science and technology ▪ The actuality of Engels' work
- S064-A** University Place 3.204
Science x Medicine: Promiscuous Objects, Entangled Problems
- S069-A** Roscoe 2.2
Putting the human sciences to work: managing human minds and bodies in the twentieth century ▪ Governing minds and bodies with the human sciences
- S092-H** Schuster Blackett
Astronomy and its applications in ancient and medieval societies ▪ Ptolemy Graecus, Arabus, Latinus, part 1
- S096-A** Roscoe 2.4
The making of transnational science: scientific contacts between China and the West during the late Qing and Republican China
- S112-E** University Place 1.218
Geology in art and literature ▪ Communicating geological knowledge
- T190-A** University Place 2.218
Literary approaches in the history of science, technology and medicine ▪ Literary approaches

Excursions, off-site tours and visits

Jodrell Bank Observatory excursion (Wednesday)
(X223)
09:15–13:00

Committee meetings

Scientific Instrument Commission business meeting
(C253)
09:00–10:30, Schuster Rutherford

09:10–10:40

- S035** Roscoe 1.008
Image and context: visual representations and the boundaries of scientific practice
- S036-A** University Place 3.205
Systems biology: a paradigm at work?
- S060-C** Roscoe 1.010
The transmission of medical knowledge in the Islamic world
- S088-A** Roscoe 2.3
Expanding women's sphere: knowledge and the re-definition of women's work in the twentieth century
- S107-A** Roscoe 2.5
Poincaré's *Méthodes nouvelles de la mécanique céleste* in historical context: bridging the frontiers of knowledge in mathematics, astronomy and wireless tech ▪ Wireless technology and theory, 1896-1914
- S111-A** University Place 1.219
Geography and its publics ▪ Multiple publics, part 1
- P120-A** Schuster Moseley
Eighth annual symposium on the social history of military technology, incorporating the Gunpowder Study Group ▪ Premodern military technology
- P123-B** Schuster Bragg
The invisible bicycle: new insights into bicycle history ▪ Adoption, appropriation, demonstration
- T183-A** University Place 4.205
Twentieth-century sciences in comparative (inter)national contexts ▪ Mid twentieth-century applied sciences
- T201-A** University Place 4.214
History of technology ▪ Ships
- T204-A** University Place 4.212
Science and technology museums in context ▪ Science and technology collections in museums

Special sessions

Historical and contemporary communications technologies in Africa: a case study in Cameroon and wider reflections ▪ Generating knowledge (E047-A)
09:10–10:40, University Place 2.219

late morning and lunchtime • 24 July WEDNESDAY

11:00–12:30

S015-B Roscoe 1.009
Novel expertise and emerging specialists

S022-B University Place 4.204
From natural history to ecology: towards a comparative history of life sciences in the long nineteenth century

S029-B Roscoe 1.007
Visual, material and empirical culture in early-modern Iberian science: artifacts, regiments, vessels, nautical charts, natural specimens, cosmographers, naturalist and pilots

S031-B University Place 4.213
The contribution of Friedrich Engels in the history of science and technology • Analyzing Engels' work

S039-A University Place 4.206
Literary history and the history of science • Scientific institutions and literary culture

S064-B University Place 3.204
Science x Medicine: Promiscuous Objects, Entangled Problems

S069-B Roscoe 2.2
Putting the human sciences to work • Culture and constructing citizens with the human sciences

S092-J Schuster Blackett
Astronomy and its applications in ancient and medieval societies • Ptolemy Graecus, Arabus, Latinus, part 2

S096-B Roscoe 2.4
The making of transnational science: scientific contacts between China and the West during the late Qing and Republican China

W131-E Schuster Rutherford
32nd Scientific Instrument Symposium • The ravages of time

T190-B University Place 2.218
Literary approaches in the history of science, technology and medicine • Literary sources in HSTM

Special sessions

Screening: John Milne documentary (E307)
11:00–12:30, University Place 1.218

Historical and contemporary communications technologies in Africa: a case study in Cameroon and wider reflections • Using knowledge (E047-B)
11:10–12:40, University Place 2.219

Walks and tours around the Congress site

Manchester Museum tour (M363)
12:00–13:00, Manchester Museum

Manchester Museum tour (M364)
13:00–14:00, Manchester Museum

Campus history walk: North Campus (M244)

11:10–12:40

S036-B University Place 3.205
Systems biology: a paradigm at work?

S088-B Roscoe 2.3
Expanding women's sphere: knowledge and the re-definition of women's work in the twentieth century

S107-B Roscoe 2.5
Poincaré's *Méthodes nouvelles de la mécanique céleste* in historical context: bridging the frontiers of knowledge in mathematics, astronomy and wireless tech • Early applications of Poincaré's *Méthodes nouvelles* in celestial mechanics and mathematics

S111-B University Place 1.219
Geography and its publics • Multiple publics, part 2

P120-B Schuster Moseley
Eighth annual symposium on the social history of military technology, incorporating the Gunpowder Study Group • Early modern guns and forts

P123-C Schuster Bragg
The invisible bicycle: new insights into bicycle history • Cycling down by the memory lane

T177-A Roscoe 1.008
Images and models in modern medicine • Visual cultures in modern medicine

T183-B University Place 4.205
Twentieth-century sciences in comparative (inter)national contexts • UK state institutions in the twentieth century

T201-B University Place 4.214
History of technology • Aeronautics and infrastructures

T204-B University Place 4.212
Science and technology museums in context • Museum, history and nation

13:00–14:30, Walk starts outside the main entrance to the Manchester Museum

Excursions, off-site tours and visits

Working Class Movement Library tour (X359)
12:00–13:00, Working Class Movement Library

Heritage bus trip and tour of the Museum of Transport (X360)
13:30–16:30, Bus departs from University Place to the Museum of Transport

Lunchtime sessions

Publishers' advice session: thesis to book (Manchester University Press) (F315)
13:00–13:45, University Place 4.206

Careers and funding: public engagement in the history of science, technology and medicine (F318)
13:00–13:45, University Place 4.205

WEDNESDAY 24 July ▪ early afternoon

14:00–15:30

S022-C **University Place 4.204**

From natural history to ecology: towards a comparative history of life sciences in the long nineteenth century

S039-B **University Place 4.206**

Literary history and the history of science ▪ Literary knowledge, scientific knowledge, and literary form

S059-A **Roscoe 1.009**

Space at work: space programmes, the environment and nuclear technology ▪ Space programmes and nuclear technology

S071-A **Roscoe 2.2**

The science of man? Bounds of knowledge in the twentieth century

S076-A **Roscoe 1.007**

Theology at work in science / Science at work in theology

S089-A **University Place 3.204**

Beyond the animal model: Linking humans and animals in modern medicine

S098-A **Roscoe 2.4**

Religion and natural knowledge in the encounter of East Asia with Europe, 1600-1800

S129-A **Schuster Blackett**

Islamic astronomy in its cultural context ▪ Cosmography and hay'a

W131-F **Schuster Rutherford**

32nd Scientific Instrument Symposium ▪ Instruments for exploration

T186 **University Place 4.213**

Ecology, conservation, environment

T192-A **University Place 2.218**

Medicine and the media

14:10–15:40

S010-A **Roscoe 1.010**

The introduction of mathematics in Iberoamerica (part II) ▪ The foundations of mathematics

S021-A **University Place 4.212**

Industrial heritage and history of technology in the Luso-Brazilian world

S023-A **University Place 2.219**

Wiring intelligence

S081-A **Roscoe 2.5**

Between physics and technology: the embodiment of knowledge in the inter-war period

S110-A **Roscoe 2.3**

Homemade science: domestic sites and the gendering of knowledge

S111-C **University Place 1.219**

Geography and its publics ▪ Geopolitics and exploration, part 1

P120-C **Schuster Moseley**

Eighth annual symposium on the social history of military technology, incorporating the Gunpowder Study Group ▪ Military technology in the long nineteenth century

P121 **Schuster Bragg**

Men, knowledge and technologies in the development of the modern oil industry up to the early decades of the twentieth century

T177-B **Roscoe 1.008**

Images and models in modern medicine ▪ Models and worldviews

T183-C **University Place 4.205**

Twentieth-century sciences in comparative (inter)national contexts ▪ Modern French science: economy and institutions

T201-C **University Place 4.214**

History of technology ▪ Knowledge transfer in universities and industry

Excursions, off-site tours and visits

People's History Museum tour (X361)

14:00–15:00, People's History Museum

A smellwalk of Manchester: can you smell Chinatown from here? (X383)

14:00–16:00, Walk starts outside the main entrance to the Manchester Museum

Imperial War Museum North tour: 'Saving Lives' (X362)

15:00–15:30, Imperial War Museum North

Committee meetings

DHST General Assembly 1 (C272-A)

14:00–15:30, University Place LT A and B

late afternoon and evening ▪ 24 July WEDNESDAY

16:00–17:30

S039-C **University Place 4.206**
Literary history and the history of science ▪
Historicism in science and literature

S059-B **Roscoe 1.009**
Space at work: space programmes, the environment
and nuclear technology ▪ Space programmes and the
environment

S071-B **Roscoe 2.2**
The science of man? Bounds of knowledge in the
twentieth century

S076-B **Roscoe 1.007**
Theology at work in science / Science at work in
theology

S089-B **University Place 3.204**
Beyond the animal model: Linking humans and
animals in modern medicine

S098-B **Roscoe 2.4**
Religion and natural knowledge in the encounter of
East Asia with Europe, 1600-1800

S129-B **Schuster Blackett**
Islamic astronomy in its cultural context ▪
Observational astronomy and its applications

W131-G **Schuster Rutherford**
32nd Scientific Instrument Symposium ▪ Instruments
and public health

T151 **University Place 4.213**
Philosophical issues

T192-B **University Place 2.218**
Medicine and the media

16:10–17:40

S010-B **Roscoe 1.010**
The introduction of mathematics in Iberoamerica (part
II)

S021-B **University Place 4.212**
Industrial heritage and history of technology in the
Luso-Brazilian world

S023-B **University Place 2.219**
Wiring intelligence

S081-B **Roscoe 2.5**
Between physics and technology: the embodiment of
knowledge in the inter-war period

S110-B **Roscoe 2.3**
Homemade science: domestic sites and the
gendering of knowledge

S111-D **University Place 1.219**
Geography and its publics ▪ Geopolitics and
exploration, part 2

P120-D **Schuster Moseley**
Eighth annual symposium on the social history of
military technology, incorporating the Gunpowder
Study Group ▪ From the late nineteenth century to the
First World War

T177-C **Roscoe 1.008**
Images and models in modern medicine ▪ Medical
techniques and medical knowledge

Special sessions

**Of music, engineers and drugs: when Cottonopolis
became Madchester (E343)**
16:00–17:30, University Place 1.218

Screening: A City Speaks (E336)
18:00–19:30, Schuster Bragg

Walks and tours around the Congress site

Campus history walk (M245)
17:45–18:30, Walk starts outside the main entrance
to the Manchester Museum WITHDRAWN

Committee meetings

DHST General Assembly 1 (C272-B)
16:00–17:30, University Place LT A and B

Public event

Chemists, brewers and beer-doctors (L348)
20:00–20:45, Jabez Clegg

Receptions

**Annals of Science anniversary reception (invitation
only) (R330)**
17:30–19:00, Uni Place 4.209

Women in Science Research Network launch (R328)
18:30–20:30, Manchester Museum

Social programme

Comedy: Bright Club (K333)
21:00–22:30, Jabez Clegg

THURSDAY 25 July ▪ early morning

09:00–10:30

S001-A **Roscoe 1.009**
Knowledge preserved, knowledge lost: challenges in collecting and interpreting material culture of science and technology ▪ Knowledge preserved

S008-A **University Place 3.204**
Science as Public Culture revisited ▪ Institutions

S009 **Roscoe 2.2**
Leonardo da Vinci and the history of science

S034-A **University Place 4.206**
From patronage to biotech: new perspectives on medicine and commerce

S043-A **University Place 1.218**
Creating facts: disputed knowledge-claims in the nineteenth century ▪ Establishing and standardizing knowledge

S055-A **University Place 4.204**
Putting knowledge to war: research, development and the image of science in the First World War

S070-A **Roscoe 1.007**
Transferring and forming pharmaceutical knowledge: from practical work to academic disciplines and back, from the seventeenth to twenty-first centuries ▪ Documenting pharmaceutical knowledge

S095-A **University Place 2.218**
Using modern computing power to analyse and explicate ancient astronomical sources: opportunities and challenges

S117-A **Roscoe 2.4**
The institutionalization of mathematics and the founding of national societies

W131-H **Schuster Rutherford**
32nd Scientific Instrument Symposium ▪ Innovative optical instruments

T153-A **University Place 4.213**
New themes and approaches in science studies ▪ Interdisciplinarity

09:10–10:40

S012-A **Roscoe 1.010**
Arabic foundations of science ▪ Demonstration and empiricism in Avicenna

S014-A **Roscoe 2.5**
Fossil work: making paleontological specimens and knowledge

S042-A **University Place 4.205**
Practising photography in the sciences

S048 **University Place 4.212**
Putting Chinese natural knowledge to work in the long eighteenth century

S078-A **University Place 2.219**
Collecting and using oral histories of science and technology: international perspectives

S082-A **Roscoe 1.008**
Ideological blueprints: rational choice, equilibrium and planned development in economics ▪ Equilibrium and rational choice

S093-A **Roscoe 2.3**
New perspectives on classification and methodology in history of science: theoretical and technological bases for managing primary sources

S111-E **University Place 1.219**
Geography and its publics ▪ Geographical education and knowledge, part 1

S116-A **University Place 3.205**
The history and philosophy of mathematical optimization

P120-E **Schuster Moseley**
Eighth annual symposium on the social history of military technology, incorporating the Gunpowder Study Group ▪ Between the wars

Q127-A **Schuster Bragg**
ICOHTEC special topics in the history of technology

T160-A **University Place 4.214**
Topics in nineteenth-century physics ▪ Eighteenth- and nineteenth-century physical sciences

Excursions, off-site tours and visits

Jodrell Bank Observatory excursion (Thursday) (X224)
09:15–13:00

Chatsworth House excursion (X231)
09:30–17:30

late morning and lunchtime ▪ 25 July THURSDAY

11:00–12:30

S001-B **Roscoe 1.009**
Knowledge preserved, knowledge lost: challenges in collecting and interpreting material culture of science and technology ▪ Knowledge lost

S008-B **University Place 3.204**
Science as Public Culture revisited ▪ Media

S034-B **University Place 4.206**
From patronage to biotech: new perspectives on medicine and commerce

S043-B **University Place 1.218**
Creating facts: disputed knowledge-claims in the nineteenth century ▪ Communicating and disputing knowledge-claims

S055-B **University Place 4.204**
Putting knowledge to war: research, development and the image of science in the First World War

S070-B **Roscoe 1.007**
Transferring and forming pharmaceutical knowledge: from practical work to academic disciplines and back, from the seventeenth to twenty-first centuries ▪ Transferring pharmaceutical knowledge

S095-B **University Place 2.218**
Using modern computing power to analyse and explicate ancient astronomical sources: opportunities and challenges

S117-B **Roscoe 2.4**
The institutionalization of mathematics and the founding of national societies

W131-J **Schuster Rutherford**
32nd Scientific Instrument Symposium ▪ Mathematical instruments for royalty and the rich

T153-B **University Place 4.213**
New themes and approaches in science studies ▪ Current problems and approaches

T162 **Roscoe 2.2**
Aspects of the history of modern chemistry

Walks and tours around the Congress site

Manchester Museum tour (M372)
12:00–13:00, Manchester Museum

Campus history walk (M246)
13:00–13:45, Walk starts outside the main entrance to the Manchester Museum

Manchester Museum tour (M373)
13:00–14:00, Manchester Museum

Manchester Museum herbarium tour (M374)
13:00–14:00, Manchester Museum

Committee meetings

Teaching Commission business meeting (C283)
12:45–13:45, University Place 3.205

11:10–12:40

S012-B **Roscoe 1.010**
Arabic foundations of science ▪ Foundations of science from Avicenna onwards

S014-B **Roscoe 2.5**
Fossil work: making paleontological specimens and knowledge

S042-B **University Place 4.205**
Practising photography in the sciences

S078-B **University Place 2.219**
Collecting and using oral histories of science and technology: international perspectives

S082-B **Roscoe 1.008**
Ideological blueprints: rational choice, equilibrium and planned development in economics ▪ Beyond, before and beneath planned welfare

S093-B **Roscoe 2.3**
New perspectives on classification and methodology in history of science: theoretical and technological bases for managing primary sources

S111-F **University Place 1.219**
Geography and its publics ▪ Geographical education and knowledge, part 2

S116-B **University Place 3.205**
The history and philosophy of mathematical optimization

P120-F **Schuster Moseley**
Eighth annual symposium on the social history of military technology, incorporating the Gunpowder Study Group ▪ Second World War military technology

Q127-B **Schuster Bragg**
ICOHTEC special topics in the history of technology ▪ Knowing users: social demands in shaping technology and designing products

T160-B **University Place 4.214**
Topics in nineteenth-century physics ▪ Discipline and metrology

Lunchtime sessions

Metrics and journal rankings: a workshop (F316)
13:00–13:45, University Place 4.204

Careers and funding: policy advisors and history (F319)
13:00–13:45, University Place 4.205

Excursions, off-site tours and visits

Godlee Observatory visit (X375)
various times, Godlee Observatory

Working Class Movement Library tour (X367)
12:00–13:00, Working Class Movement Library

THURSDAY 25 July ▪ afternoon and evening

Plenary

IAHS keynote address and prize award ceremonies (A392)

14:00–15:30, Schuster Rutherford

Committee meetings

IAHS General Assembly (C274)

15:45–17:45, Schuster Rutherford

Walks and tours around the Congress site

University of Manchester Museum of Medicine and Health collections (M387)

14:00–16:00

Excursions, off-site tours and visits

Godlee Observatory visit (X375)

various times, Godlee Observatory

Quarry Bank Mill and Styal Estate excursion (X232)

12:45–17:30

Modernist Manchester walk (X390)

13:00–15:30, Walk starts at University Place

Police Museum tour (X368)

13:30–15:30, Police Museum

People's History Museum tour (X369)

14:00–15:00, People's History Museum

Chetham's Library tour (X386)

14:00–15:30, Chetham's Library

Guided walk: Victorian and Edwardian Manchester (X365)

14:00–16:30, Walk starts by the giant pebble on Barbirolli Square outside Bridgewater Hall

Guided walk: Manchester peace and justice trail (X366)

14:00–16:30, Walk starts by the giant pebble on Barbirolli Square outside Bridgewater Hall

Museum of Science and Industry tours, plus: meet the curators and archivists (X233)

14:00–17:00, Museum of Science and Industry

National Media Museum tour in Bradford (X387)

14:30–16:00, National Media Museum, Bradford

National Railway Museum tour in York (X385)

14:30–16:30, National Railway Museum, York

Imperial War Museum North tour: 'Saving Lives' (X370)

15:00–15:30, Imperial War Museum North

Imperial War Museum North tour: 'Saving Lives' (X371)

16:00–16:30, Imperial War Museum North

Social programme

Museum of Science and Industry reception (J324)

19:00–21:00, Museum of Science and Industry

Music: Dave Haslam, Haçienda DJ (K334)

21:00–23:00, Jabez Clegg

FRIDAY 26 July ▪ early morning

09:00–10:30

S044-A University Place 4.213

Forensic histories: global perspectives ▪ Spaces and traces: global takes on forensic investigation in the late nineteenth and early twentieth centuries

S097-A Roscoe 2.2

From antiquity to tradition? Innovation and the past in East Asian science, technology and medicine, from the seventeenth to the twentieth century ▪ Antiquity and tradition before the colonial eras

S102-A University Place 2.218

The historical and cultural dimensions of Islamic science ▪ Transmission of knowledge over time and between cultures

S103-A University Place 1.218

Gaining it / losing it/ regaining it(?) Knowledge production in climate science, status anxiety, and authority across disciplines ▪ Climates of conquest? Anxieties about climate variability and change in Africa, the Americas, Asia and Australia

S117-C Roscoe 2.4

The institutionalization of mathematics and the founding of national societies

W131-K Schuster Rutherford

32nd Scientific Instrument Symposium ▪ Heritage and collections

T161-A Schuster Blackett

Modern physics and astronomy at work ▪ Twentieth-century astronomy

T166-A Roscoe 1.007

Eighteenth- and nineteenth-century biological sciences ▪ Networks of circulation and exchange

T170 University Place 4.204

Medicine and colonialism

T195-A Roscoe 1.009

Science education ▪ The role of HSTM in teaching to scientists, medics and engineers

09:10–10:40

S005-A Roscoe 2.3

Mathematics and machines: explorations of machine-assisted mathematics since 1800 ▪ Approaching machines and mathematics

S007-A University Place 4.205

Dynamics of knowledge: how technologies evolve, triumph and die ▪ What is progress?

S066-A University Place 2.219

Planet Earth, the environment, and the Cold War ▪ A 'Red' International Geophysical Year? Alliances and divisions in episodes of international scientific collaboration

S104-A Roscoe 1.010

Materials and chemistry from bench to brand and back ▪ Early synthetic materials

S113-A University Place 1.219

Geologists in the field ▪ Methodology of fieldwork

P120-G Schuster Moseley

Eighth annual symposium on the social history of military technology, incorporating the Gunpowder Study Group ▪ Weapons of mass destruction

T158-A Roscoe 1.008

Knowledge and experiment in natural philosophy ▪ Working with Newton: contexts of Newtonianism in the eighteenth century

T175-A University Place 3.205

Contemporary medical practice and ethics

Committee meetings

Women and Gender Studies Commission business meeting (C251)

09:00–10:30, University Place 3.204

CHAMA business meeting (C255-A)

09:10–10:40, Roscoe 2.5

History of Geography IUC business meeting (C257)

09:10–10:40, University Place 4.214

Excursions, off-site tours and visits

Jodrell Bank Observatory excursion (Friday) (X225)

09:15–13:00

late morning and lunchtime • 26 July FRIDAY

11:00–12:30

S044-B **University Place 4.213**
Forensic histories: global perspectives • Questions of expertise: experts in criminal investigations and criminal trials

S094-A **University Place 3.204**
History of science and the ecology of knowledge: the limitations, expectations, and needs of four knowledge communities

S097-B **Roscoe 2.2**
From antiquity to tradition? Innovation and the past in East Asian science, technology and medicine • Transmission and traditions: East Asian versus Western technology and medicine

S102-B **University Place 2.218**
The historical and cultural dimensions of Islamic science • Medicine in context

S103-B **University Place 1.218**
Gaining it / losing it/ regaining it(?) Knowledge production in climate science, status anxiety, and authority across disciplines • Narratives on climate and water

S117-D **Roscoe 2.4**
The institutionalization of mathematics and the founding of national societies

W131-L **Schuster Rutherford**
32nd Scientific Instrument Symposium • The big picture: documenting and displaying historic instruments and their makers

T161-B **Schuster Blackett**
Modern physics and astronomy at work • Theory in early twentieth-century physics

T166-B **Roscoe 1.007**
Eighteenth- and nineteenth-century biological sciences • The history and philosophy of biology

T191 **Roscoe 1.009**
Science and art

T197-A **University Place 4.206**
History and historiography of the history of science, technology and medicine • Histories of the history of science, technology and medicine

Walks and tours around the Congress site

Manchester Museum tour (M380)
12:00–13:00, Manchester Museum

Campus history walk: physics (M247)
13:00–13:45, Walk starts outside the main entrance to the Manchester Museum

Manchester Museum tour (M381)
13:00–14:00, Manchester Museum

Excursions, off-site tours and visits

Working Class Movement Library tour (X376)
12:00–13:00, Working Class Movement Library

11:10–12:40

S005-B **Roscoe 2.3**
Mathematics and machines: explorations of machine-assisted mathematics since 1800 • Numerical mathematics and analog computing

S007-B **University Place 4.205**
Dynamics of knowledge: how technologies evolve, triumph and die • Constructing technologies

S066-B **University Place 2.219**
Planet Earth, the environment, and the Cold War • Resources and national security

S104-B **Roscoe 1.010**
Materials and chemistry from bench to brand and back • Late advanced materials

S113-B **University Place 1.219**
Geologists in the field • The importance of place

P120-H **Schuster Moseley**
Eighth annual symposium on the social history of military technology, incorporating the Gunpowder Study Group • Cold War military technology

T158-B **Roscoe 1.008**
Knowledge and experiment in natural philosophy • Sixteenth- and seventeenth-century natural philosophy

T175-B **University Place 3.205**
Contemporary medical practice and ethics

Committee meetings

CHAMA business meeting (C255-B)
11:10–12:40, Roscoe 2.5

Pacific Circle Commission business meeting (C263)
11:10–12:40, University Place 4.214

Special sessions

Nineteenth-century geological sections (lunchtime viewing session) (E337)
13:00–13:30, University Place 1.219

Committee meetings

Meteorology Commission business meeting (C254)
12:45–13:45, University Place 1.218

BSHS EGM (C275)
12:45–13:45, Schuster Blackett

FRIDAY 26 July ▪ early afternoon

14:00–15:30

S030-A **Roscoe 1.009**
Is it the medium? Ways of communicating science in twentieth-century Europe ▪ Print, radio, news-reel

S056-A **University Place 4.213**
Medical knowledge traditions at work

S094-B **University Place 3.204**
History of science and the ecology of knowledge: the limitations, expectations, and needs of four knowledge communities

S097-C **Roscoe 2.2**
From antiquity to tradition? Innovation and the past in East Asian science, technology and medicine, from the seventeenth to the twentieth century ▪ Antiquity, tradition and self-construction in the age of nationalism, part 1

S102-C **University Place 2.218**
The historical and cultural dimensions of Islamic science ▪ Mathematics, physics, and the heavens

S103-C **University Place 1.218**
Gaining it / losing it/ regaining it(?) Knowledge production in climate science, status anxiety, and authority across disciplines ▪ Working atmospheres: histories of climate, technology and economics

T161-C **Schuster Blackett**
Modern physics and astronomy at work ▪ Techniques in modern physics

T166-C **Roscoe 1.007**
Eighteenth- and nineteenth-century biological sciences ▪ Philosophy, race, ethnography

T172-A **University Place 4.204**
The politics of public health ▪ Public cultures of nineteenth-century medicine

T197-B **University Place 4.206**
History and historiography of the history of science, technology and medicine ▪ Nineteenth- and twentieth-century humanities and social sciences

14:10–15:40

S005-C **Roscoe 2.3**
Mathematics and machines: explorations of machine-assisted mathematics since 1800 ▪ Mathematics through the machine's eye: the advent of digital computing

S066-C **University Place 2.219**
Planet Earth, the environment, and the Cold War ▪ Environmental monitoring and the ideological battlefield in the environmental sciences

S104-C **Roscoe 1.010**
Materials and chemistry from bench to brand and back ▪ Infrastructure, instruments & ideas

S113-C **University Place 1.219**
Geologists in the field ▪ Constraints on fieldwork

T158-C **Roscoe 1.008**
Knowledge and experiment in natural philosophy ▪ Prints, texts and readings

T178-A **University Place 4.205**
Science, medicine, industry and markets ▪ Medicine, science and industry

T179 **University Place 3.205**
Bio/medical practices

T196-A **University Place 4.214**
Pedagogy and textbooks ▪ Mathematical and technical pedagogy

Special sessions

The tables turned: Victorian séance event (E310)
14:00–15:30, Pear Lecture Theatre, Coupland 1 Building

Committee meetings

History of Astronomy IUC business meeting (C269)
15:00–15:30, University Place 4.212

Excursions, off-site tours and visits

Victorian street tour at Salford Museum and Art Gallery (X377)
14:00–15:00, Salford Museum and Art Gallery

People's History Museum tour (X378)
14:00–15:00, People's History Museum

Imperial War Museum North tour: 'Saving Lives' (X379)
15:00–15:30, Imperial War Museum North

late afternoon and evening ▪ 26 July FRIDAY

16:00–17:30

S030-B **Roscoe 1.009**
Is it the medium? Ways of communicating science in twentieth-century Europe ▪ Exhibition, museum, TV

S056-B **University Place 4.213**
Medical knowledge traditions at work

S103-D **University Place 1.218**
Gaining it / losing it/ regaining it(?) Knowledge production in climate science, status anxiety, and authority across disciplines ▪ Climate change discourse and the case of the Intergovernmental Panel on Climate Change (IPCC)

T172-B **University Place 4.204**
The politics of public health ▪ Topics in eighteenth-century medicine

T176 **Roscoe 2.2**
East Asian medicine

T197-C **University Place 4.206**
History and historiography of the history of science, technology and medicine ▪ Professional issues in HSTM

16:10–17:40

S005-D **Roscoe 2.3**
Mathematics and machines: explorations of machine-assisted mathematics since 1800 ▪ Programming mathematics on digital computers

S104-D **Roscoe 1.010**
Materials and chemistry from bench to brand and back ▪ Modelling natural materials

S113-D **University Place 1.219**
Geologists in the field ▪ Fieldwork case studies

T178-B **University Place 4.205**
Science, medicine, industry and markets ▪ Medical markets

T196-B **University Place 4.214**
Pedagogy and textbooks ▪ Educational contexts

Special sessions

Neu-Whitrow Bibliography Prize presentation and Commission on Bibliography and Documentation business meeting (E300)

16:00–17:30, University Place 3.204

Screening: Ernest Rutherford documentary (E306)

16:00–17:30, Schuster Blackett

Committee meetings

CHOSTIS business meeting (C258)

16:00–17:30, University Place 2.218

ICOHTEC General Assembly (C267)

16:00–17:30, Schuster Rutherford

History of Mathematics IUC business meeting (C262)

16:10–17:40, University Place 2.219

IASCUD Executive Committee meeting 2 (C282)

16:10–17:40, University Place 4.212

East Asia Commission business meeting (C266)

17:45–19:00, Room 2.57, Simon Building

Walks and tours around the Congress site

Campus history walk: chemistry (M248)

17:45–18:30, Walk starts outside the main entrance to the Manchester Museum

Public event

BSHS Dingle Prize lecture: David Wright, *Downs: the history of a disability* (L341)

18:00–19:00, Kanaris Lecture Theatre, Manchester Museum

The tables turned: Victorian séance event (L344)

19:30–21:00, Portico Library

Receptions

History of Mathematics IUC reception (R329)

17:30–19:00, Uni Place Restaurant

Literary and Philosophical Society reception (R327)

17:30–18:45, Schuster Foyer

Social programme

Email Special (jazz) (K335)

21:00–23:00, Jabez Clegg

SATURDAY 27 July ▪ early morning

09:00–10:30

S003-A Roscoe 1.009

Historical development, contemporary investigations and perspectives of the logical and philosophical foundations of science, technology and medicine ▪ The logical foundations of scientific knowledge

S004 University Place 2.218

Colonial science at work

S052-A University Place 4.206

The work of medical schools since the Second World War: the reconfiguration of knowledge, practice and pedagogy ▪ The identity, space and organization of medical education

S077-A University Place 1.218

Transnational nuclear perspectives

S101-A Roscoe 2.4

Ancient cultural and technological interactions between East and West along the Silk Road

T157-A Roscoe 2.2

Pre-modern astronomy and cosmology ▪ Early astronomical contexts

T180-A University Place 3.204

Scientific expeditions, travels and colonialism ▪ Colonial expeditions

T202 University Place 4.204

Information technology, communications, networks

T203-A Roscoe 1.007

Technical cultures of practice and knowledge ▪ Pre- and early-modern texts and technologies

09:10–10:40

S006-A Roscoe 1.010

Empires of longitude: international perspectives on navigation, mapping and science ▪ State interests

S018-A Roscoe 2.5

Global Spencerism

S028-A Roscoe 1.008

Genetics, eugenics and culture: transatlantic perspectives, 1900-2000

S061-A Roscoe 2.3

Re-creating past science and technology

S113-E University Place 1.219

Geologists in the field ▪ Travels and new worlds

P119-A Schuster Moseley

Everlasting bath: the history of sauna technology and culture ▪ Technological basis and social context

Q127-C Schuster Bragg

ICOHTEC special topics in the history of technology ▪ Just applied science? The origins of technological knowledge

T156-A University Place 4.212

Topics in the history of modern mathematics ▪ Mathematical institutions and communities in modern Brazil

T171-A University Place 4.205

Medical authority boundaries and medical knowledge ▪ Eighteenth- and nineteenth-century medicine

T174-A University Place 2.219

Twentieth-century medicine ▪ Cancer

late morning and lunchtime ▪ 27 July SATURDAY

11:00–12:30

S003-B Roscoe 1.009

Historical development, contemporary investigations and perspectives of the logical and philosophical foundations of science, technology and medicine ▪ Philosophico-methodological problems of mathematics and physics in the process of their historical development

S052-B University Place 4.206

The work of medical schools since the Second World War: the reconfiguration of knowledge, practice and pedagogy ▪ Policy and specialisms in medical education

S077-B University Place 1.218

Transnational nuclear perspectives

S101-B Roscoe 2.4

Ancient cultural and technological interactions between East and West along the Silk Road

T157-B Roscoe 2.2

Pre-modern astronomy and cosmology ▪ Astronomy and instruments in Asian contexts

T180-B University Place 3.204

Scientific expeditions, travels and colonialism ▪ Eighteenth- and nineteenth-century colonialism and travel

T184 University Place 2.218

International organisations in twentieth-century science, technology and medicine

T203-B Roscoe 1.007

Technical cultures of practice and knowledge ▪ Skills, knowledges and practical work

11:10–12:40

S006-B Roscoe 1.010

Empires of longitude: international perspectives on navigation, mapping and science ▪ Knowledge in circulation

S018-B Roscoe 2.5

Global Spencerism

S028-B Roscoe 1.008

Genetics, eugenics and culture: transatlantic perspectives, 1900-2000

S061-B Roscoe 2.3

Re-creating past science and technology

S113-F University Place 1.219

Geologists in the field ▪ Landscapes and meaning

P119-B Schuster Moseley

Everlasting bath: the history of sauna technology and culture ▪ Cultural heritage and scientific knowledge

P132 Schuster Bragg

Sonic skills at work: listening as an entrance to knowledge acquisition

T156-B University Place 4.212

Topics in the history of modern mathematics ▪ Biographies and contexts in history of maths

T171-B University Place 4.205

Medical authority boundaries and medical knowledge ▪ Medical boundaries and disputes

T174-B University Place 2.219

Twentieth-century medicine ▪ Asian, Pacific and Western medicine

Committee meetings

Modern Chemistry Commission business meeting (C252)

11:10–12:40, University Place 4.214

Walks and tours around the Congress site

Campus history walk: biology and medicine (M249)

13:00–13:45, Walk starts outside the main entrance to the Manchester Museum

SATURDAY 27 July, early afternoon

14:00–15:30

S003-C **Roscoe 1.009**
Historical development, contemporary investigations and perspectives of the logical and philosophical foundations of science, technology and medicine ▪ Epistemological and ontological aspects of scientific knowledge

S038-A **University Place 4.204**
“A work to be done”: the manual and the cognitive in early-modern science

S049-A **University Place 3.204**
Science and optical media: imaging technologies, knowledge formation and the rise of the scientific imagination ▪ Optical media and scientific practices

S077-C **University Place 1.218**
Transnational nuclear perspectives

T157-C **Roscoe 2.2**
Pre-modern astronomy and cosmology ▪ Astronomy: techniques of the east and west

T173-A **University Place 4.206**
Medical ethics and psychology ▪ Institutions and ethics

T185-A **University Place 2.218**
Science, technology and medicine and the state ▪ Science, medicine and the authoritarian state

T195-B **Roscoe 2.4**
Science education ▪ Translating science across borders: the role of textbooks

T203-C **Roscoe 1.007**
Technical cultures of practice and knowledge ▪ Contexts of innovation

14:10–15:40

S006-C **Roscoe 1.010**
Empires of longitude: international perspectives on navigation, mapping and science ▪ Navigation, encounter and exchange

S018-C **Roscoe 2.5**
Global Spencerism

S028-C **Roscoe 1.008**
Genetics, eugenics and culture: transatlantic perspectives, 1900-2000

S054 **University Place 4.214**
Alchemy: the relationship between working and knowing from late antiquity to the seventeenth century

P124 **Schuster Moseley**
Generating knowledge in practice: experiments in the building sector

P133 **Schuster Bragg**
Knowledge for use: universities, industry and roots of the knowledge economy

T154-A **University Place 1.219**
Sources and biography

T156-C **University Place 4.212**
Topics in the history of modern mathematics ▪ Nineteenth- and twentieth-century mathematics

T171-C **University Place 4.205**
Medical authority boundaries and medical knowledge ▪ Medical boundaries of authority and expertise

T174-C **University Place 2.219**
Twentieth-century medicine ▪ Institutions

Committee meetings

DHST General Assembly 2 (C273-A)
14:00–15:30, University Place LT A and B

INHIGEO business meeting (C256-A)
14:10–15:40, Roscoe 2.3

Excursions, off-site tours and visits

Imperial War Museum North tour: ‘Saving Lives’ (X382)
15:00–Thu 25, Imperial War Museum North

late afternoon and evening ▪ 27 July SATURDAY

16:00–17:30

S038-B **University Place 4.204**
“A work to be done”: the manual and the cognitive in early-modern science

S049-B **University Place 3.204**
Science and optical media: imaging technologies, knowledge formation and the rise of the scientific imagination ▪ Scientific images and the scientific imagination

S077-D **University Place 1.218**
Transnational nuclear perspectives

T173-B **University Place 4.206**
Medical ethics and psychology ▪ Late twentieth-century psychology and psychiatry

T185-B **University Place 2.218**
Science, technology and medicine and the state ▪ Postwar physical sciences

T195-C **Roscoe 2.4**
Science education ▪ Science and education

T203-D **Roscoe 1.007**
Technical cultures of practice and knowledge ▪ Science and technology across boundaries

16:10–17:40

S018-D **Roscoe 2.5**
Global Spencerism

T154-B **University Place 1.219**
Sources and biography

T156-D **University Place 4.212**
Topics in the history of modern mathematics ▪ Problems in the history of maths in the long nineteenth century

T171-D **University Place 4.205**
Medical authority boundaries and medical knowledge ▪ Knowledge-making in modern medicine

T210 **University Place 2.219**
Islamic science and medicine

Committee meetings

DHST General Assembly 2 (C273-B)
16:00–17:30, University Place LT A and B

INHIGEO business meeting (C256-B)
16:10–17:40, Roscoe 2.3

Social programme

Congress dinner (J325)
19:00–22:00, Manchester United Football Club

Walks and tours around the Congress site

~~**Campus history walk (M250)**~~
17:45–18:30, Walk starts outside the main entrance to the Manchester Museum **WITHDRAWN**

SUNDAY 28 July

Plenary

DHST and BSHS young scholars' prize presentations and Congress closing ceremony (A399)
09:30–12:00, University Place LT A and B

Committee meeting

DHST Council meeting 2 (incoming and outgoing Council) (C284)
08:30–09:30, Room 2.57, Simon Building

S001. Knowledge preserved, knowledge lost: challenges in collecting and interpreting material culture of science and technology

Thu 25 July, 09:00–12:30 ▪ Roscoe 1.009

Symposium organisers:

Anna ADAMEK | Canada Science and Technology Museum, Canada

Peter LIEBHOLD (non-participant) | Smithsonian Institution, United States

Symposium abstract

Museums are depositories of knowledge on methods, processes, innovations, & socio-economics inherent to science & technology. It is curators' responsibility to preserve knowledge imbedded in material culture of science & technology. This job poses interesting challenges. Perceptions, priorities, practical considerations, gender bias, and personal interests influence decisions on what is saved and what is lost. The need to preserve artifacts is balanced against access to data that they carry. In this Symposium American, Canadian & European museum professionals discuss issues associated with collecting and studying scientific & technological artifacts. **Franz Klingender**, Canada Agriculture Museum, in *Canada Is A Mighty Big Country and I Can Hear The Warehouse Walls Groaning* examines the institution's mandate to collect the country's history of science & technology. If it were ever realistic to expect that such a mandate could be fulfilled, in today's climate it is no longer possible. We need to ask whether a different preservation model should be considered. **Marzena Wozny**, Museum of Archaeology, Krakow talks about *Unique archaeological documentation*, Gabriel Leńczyk's sketches of medieval defensive structures. Leńczyk conducted extensive archaeological excavations and pioneered an inventory of hillforts in Poland. As time and human intrusion alter the landscape, the Leńczyk's sketches become very valuable. **Gosia Taborska**, Jagiellonian University Museum, discusses *Scientific Instruments & Laboratory Equipment as Museum Exhibits*. Scientific instruments constitute a special group of museum artifacts that testify to the evolution of scientific methods & development of new technologies. Sadly, only a fraction of instruments ends up in the Museum. The Museum is educating University employees about heritage value of equipment and principles of acquisitions. **Anna Adamek**, Canada Science & Technology Museum, in *My Wife Said This Sh*t Has to Go* examines gender dynamics in donations. Majority of objects are donated by men or by wives & daughters to honour work and lives of husbands and fathers. Few donations preserve women's contribution to science, technology & medicine. The paper looks at reasons for this trend & strategies employed to mitigate the situation. **Zbigniew Stachniak**, York University, Toronto discusses testing of computer artifacts. One of the main issues in the history of computing is how to conduct research that requires experimentation with hardware. The hardware may not exist any more, or be fragile; it can be displayed but not manipulated.

S001-A. Knowledge preserved

Thu 25 July, 09:00–10:30 ▪ Roscoe 1.009

Chair: Deborah SCOTT | Fleming College, Canada

Peter LIEBHOLD | Smithsonian Institution, United States

WITHDRAWN: Collecting problematic history

Franz KLINGENDER | Canada Agricultural Museum, Canada

Canada is a mighty big country and I can hear the warehouse walls groaning

Collection development is increasingly becoming a problem for museums worldwide. Often the administration does not see the need to acquire more objects or storage is already full so there is no room for more object even if a rationale could be made for their acquisition. When an institution has the mandate to collect a country's history the challenges become even greater. The Canada Agriculture Museum's collecting mandate is meant to represent all aspects of this country's agricultural story. That encompasses everything from an iron-faced wood 17th century plough pulled by a brace of oxen to a 40 foot long late 20th century robotic machine that allows four cows to be milked simultaneously when they feel the need. It is to include everything from the rake used on PEI to collect dulse for use as fertilizer to the self-propelled machine for harvesting grapes used in British Columbia's Okanagan Valley. If it were ever realistic to expect that such a mandate could be fulfilled, in today's climate of limited financial and personnel resources it clearly is no longer possible. We also need to ask whether we must be the sole custodian for everything of significance or should a different model be considered? The Canadian Museum of Nature has for many years worked within a collaborative framework that often sees them coordinating the preservation of natural history specimens but the actual specimens going into partner public institutions elsewhere in Canada. This presentation will examine why a network of partner agriculture museums may be the sole reasonable road forward, how one could be formed, the challenges involved and what it might look like.

Susanne GRUBER | Technisches Museum Wien, Austria

Objekte von der Wiener Weltausstellung 1873 in der Warenkundesammlung des Technischen Museums Wien

Als dritte Weltausstellung nach London und Paris in den Jahren 1861 und 1867, zeigte die Wiener Weltausstellung 1873 viele Produkte und Kunstgegenstände der ganzen Welt, die weitgehend unbekannt am europäischen Markt und bei den Konsumenten waren. Viele Ausstellungsstücke stießen auf großes Interesse bei den Besuchern, wie z.B. Japanische Lackarbeiten, Porzellan und Fächer, was den sogenannten Japonismus im europäischen Kunstgewerbe dieser Zeit auslöste.

Im Rahmen eines Forschungsprojektes, wurde die Geschichte der Warenkundesammlung im Technischen Museum Wien rekonstruiert und Objekte identifiziert, die auf der Wiener Weltausstellung zu sehen waren. Alle im Folgenden vorgestellten Objekte sind japanische Artefakte oder tragen japanische Inschriften.

Eine Gruppe von Teedosen aus Holz wird mit einem Etikett aufbewahrt, das die Inschrift des „Cercle Oriental.“ trägt, ein Pavillon, der speziell für die Ausstellung errichtet wurde. Alle vier Dosen sind quadratisch und haben die Abmessungen 5,7 x 5,7 x 10 cm. Sie sind aus verschiedenen Hölzern gefertigt, wie „kurogaki“, auch „Echter Kakibaum“, oder „kaya“, auch „Japanische Nusseibe“.

Zwei japanische Musterbücher mit Seidenbrokaten haben eine direkte Verbindung zum Generaldirektor der Weltausstellung, Baron Wilhelm von Schwarz-Senborn. Es sind japanische Bücher, die von links nach rechts aufgeschlagen werden, die Muster sind an der linken Buchseite montiert. Die Rückseite der Stoffe ist nicht mit einem Papier verdeckt. Dadurch sind auch die Details der Bindung zu sehen. Die Muster sind sehr aufwändig und meist sehr farbtensiv. Bei zahlreichen wertvollen Stoffen sind goldfarbene Fäden eingewebt.

Als dritter Punkt wird ein Set von sechs Japanischen bemalten Wachskerzen vorgestellt, die in einer schwarzen Box mit den Maßen 52,5 x 32 x 9 cm aufbewahrt werden. Eine Kerze ist als Bambus-Sprosse stilisiert. Eine weitere Kerze trägt die traditionellen japanischen Glückssymbole für langes Leben, Kraniche und eine Schildkröte, die aus

dem bewegten Meer auftaucht. Zwei andere Kerzen zeigen schöne Frauen in eleganten, höfischen Kleidern. Dieses Set ist ident mit den fotografierten Objekten für die japanische Ausstellung in Wien. Weitere Hinweise auf Etiketten, wie den Cercle Oriental, weisen ebenfalls darauf hin, dass diese Objekte auf der Wiener Weltausstellung 1873 zu sehen waren.

Objects from the Vienna World Exposition of 1873 in the Commodity Science Collection of the Vienna Technical Museum

Being only the third of its kind after the first two World Fairs held in London and Paris in 1861 and 1867 respectively, the Vienna World Exposition of 1873 showcased many products and artefacts from all around the world that hitherto had been largely unknown to European markets and consumers. Many of these foreign exhibits were very well received by the public, some, such as, for example, Japanese lacquers, porcelains and fans, even causing a stir that was conducive to an overall craze for things Japanese and to the so-called Japonism in European arts and crafts of the time.

As an outcome of a research project, we reconstructed the history of Commodity Science Collection of the Technical Museum Vienna and identified objects shown at the Vienna World Expo of 1873. The presented groups of objects below are Japanese artefacts or at least bear Japanese inscriptions.

A group of wooden Japanese tea caddies are preserved together with a tag that bears the imprint "Cercle Oriental.", a pavillon built for the Expo. All four tea caddies are quadrangular, measuring 5,7 x 5,7 x 10 cm, and made from various woods, such as „*kurogaki*“, or „black Japanese Persimmon“ and „*kaya*“, or „Japanese nutmeg-yew“.

Two Japanese silk fabric sample books point to their direct connection with the Expo's Austrian director general, Baron Wilhelm von Schwarz-Senborn. The Japanese-style bound books, their spine is on the right side, measure 43 x 39 x 2 cm, their covers consisting of a fabric with floral design. The reverse side of the fabrics is left uncovered, to see the weaving details. As to the designs, they are very intricate and mostly very colourful. Many fabrics have gold-coloured threads weaved into them.

And for yet a third item in the collection, the set of six superb Japanese painted wax candles, stored in a black-painted quadrangular wooden showcase, measuring 52,5 x 32 x 9 cm. One candle is imitating a bamboo sprout, one has a design of a crane flying in the air and a tortoise emerging from a wavy sea, both traditional Japanese lucky symbols for longevity. Two other candles feature a beautiful woman in an elegant courtly dress. The sets similarity to the photographed items as well as other internal evidence connecting it with the Cercle Oriental make it also highly probable that it had been on display at the World Expo in 1873.

Co-Autor, Translation: Dr. Susanne Formanek, Akademie der Wissenschaften

Commentary: [Deborah SCOTT](#) | Fleming College, Canada

S001-B. Knowledge lost

Thu 25 July, 11:00–12:30 • Roscoe 1.009

Chair: [Deborah SCOTT](#) | Fleming College, Canada

[Malgorzata TABORSKA](#) | Jagiellonian University, Poland

Scientific instruments and laboratory equipment as museum exhibits

Scientific instruments constitute a special group of museum memorabilia, valued not only as artefacts of handicraft, but also as testimony to the evolution of scientific methods, development of new technologies and progress in research. They acquire a particular value for university museums which illustrates traditions and everyday life of the school as well as achievements in researches and teaching. The Jagiellonian University Museum owns the largest collection of scientific instruments in Poland, the oldest dating from the Middle Ages (astronomical instruments from the 14th c.) and the youngest – from the 21st c. (multiwire drift chamber, 2001). Over 80% of the instruments have been given to the Museum from the equipment of the Jagiellonian University institutes and laboratories. Many of them have an interesting provenance, sometimes well documented. The main difficulty in objects acquisitions comes from the fact that only a fraction of them ends up in the Museum - usually only these that are the most cumbersome, and unwanted and at the same time difficult to transport due to their size and weight. To remedy this situation the Museum is educating the University employees about the proper way to collect old equipment and about general principles of acquisition. One of the methods used is a blurb presenting the newly acquired artifacts on the pages of the University monthly "Alma Mater" together with words of gratitude. Another method is the direct contact with the staff of the specific department or institute. A case study looks at 2011 acquisition of nearly 250 items from the Zoological Institute. This opportunity arose when the Institute was transferred to the new University Campus. The Museum was fortunate to acquire all main types of the collected artifacts, such as:

- standard scientific equipment, factory-made as well as for special applications
- prototype scientific instruments, often made in the University workshops, sometimes even by the researchers themselves,
- office materiel,
- instruments for educational purposes,
- scientific laboratory equipment connected with research apparatus.

Majority of artifacts are in good condition, sometimes needing only minor repairs or conservation care. Due to the limited space of the permanent exhibition and its historical character, most of the artifacts are kept in the storehouse to be used as a base for future thematic exhibitions.

[Anna ADAMEK](#) | Canada Science and Technology Museum, Canada

My wife said this sh*t has to go

This paper examines gender dynamics in unsolicited donations to the CSTM. Vast majority of objects that come to the CSTM through passive collecting are donated by men or donated by wives and daughters to commemorate work and lives of their husbands and fathers. Very few donations are originated by women who want to preserve another female's contribution to the science, technology and medicine. Moreover, in Adamek's 20 years at the Museum no men has ever called to donate objects associated with his mother's, wife's or daughter's work. The paper looks at possible reasons for this phenomenon and attempts to answer several key questions. What is the relationship of men and women with the CSTM? Is there a difference in the way that men and women in Canada perceive their national museum of science and technology? Do generational dynamics play a role? Is there knowledge lost because of the *silences* in the collection? What do these *silences* tell us about Canadian scientific and technological heritage? The paper also looks at strategies employed by the curator to mitigate the situation.

[Zbigniew STACHNIAK](#) | York University, Canada

Experimentation with computer hardware artefacts

One of the main research issues in the history of computing that involves computer hardware is how to conduct research that, ideally, requires extensive experimentation with the hardware itself. The researched hardware may not exist any more, may be unavailable, or be in a fragile state preventing its use. In fact, most of the computer hardware collected by science museums can be displayed but not experimented with. The hardware unavailability problem can be partially addressed by the development of emulators -- modern software that emulates the behaviour of a historical computer system. Software emulation has been initiated in late 20th century. The emulated hardware ranges from vintage game consoles and home computers to mainframe computers. While some of these emulators represent a considerable software engineering effort, little attention has been paid to the methodological issues such as the development of testable criteria to determine the degree of historical accuracy of an emulator. In his talk, Prof. Stachniak will discuss the hardware emulation efforts at York University Computer Museum from both the software engineering and methodological points of view. The presentation will also include emulation examples.

Katariina MAURANEN | Independent scholar, Finland

Rusty machines and an adze in a glass case? Technology in museum displays

Most history museums collect and display some kind of technology artefacts. These may be in dedicated technology collections or as part of other collections. However, most museums are not defined as museums of science, technology or industry. In this paper I will explore the different ways in which technology is displayed in museums with a different focus. I will also explore why some museums with technology-centred collections, such as transport museums, do not identify as technological museums.

Using shipbuilding as an example, I will look at how maritime history museums and museums of science, technology and industry differ in their approaches. Shipbuilding is often portrayed in museums by displaying hand tools in a glass case. I will explore the different interpretations different types of museums offer on rather similar artefacts and displays, and suggest possible reasons to the similarities and differences between display styles. Do maritime museums see shipbuilding as a means to an end and technology museums as significant in itself, for example? I will also suggest that displaying hand tools or machinery does not, in fact, portray shipbuilding, but simply the tools of the trade. I will show examples of a different approach to displaying an aspect of shipbuilding that considers the ideas and reasoning behind early 19th century changes in Naval Dockyards.

S002. Research in science museums: the state of the art

Tue 23 July, 09:10–17:40 • Uni Place 1.219

Symposium organisers:

Tim BOON | Science Museum, London, United Kingdom

Martin COLLINS | Smithsonian Institution, United States

Rebekah HIGGITT | Royal Museums Greenwich, United Kingdom

Helmuth TRISCHLER | Deutsches Museum, Germany

Symposium abstract

Science and technology museums have, over the last two decades, drawn closer to the universities in the pursuit of their research activities. As they have applied the insights and methodologies of STS, they have

always stressed the study of material culture and the place of museums in the cultural economy of the modern world.

Scholars and curators have taken several initiatives to promote high quality academic research into objects, collections and their broader value and significance. The Artefacts Consortium, for example (which has expanded from an original core membership of Science Museum, Deutsches Museum and Smithsonian Institution), has been running annual meetings since 1996 and has produced seven thematic collections of essays.

This symposium, over a day and a half, will ask what has been achieved; how the field has changed; and what new challenges exist for those, inside and outside the museums, who are pursuing the material and visual culture of science, technology and medicine. Has this area of study had the impact on mainstream STS that it promises and, if not, why not?

S002-A. Museum-university collaborations: an ideal marriage?

Tue 23 July, 09:10–10:40 • Uni Place 1.219

Session organiser: Rebekah HIGGITT | Royal Museums Greenwich, United Kingdom

Chair: Tim BOON | Science Museum, London, United Kingdom

Helmuth TRISCHLER | Deutsches Museum, Germany

Collaborations of research museums and universities: opportunities, challenges, problems, and experiences based on the German case

The diversified landscape of museums in Germany includes a number of so-called research museums. These institutions of national importance and international reputation, among them museums of science and technology like the Deutsches Museum in Munich and the Deutsches Schiffahrtsmuseum in Bremerhaven, have developed close links with universities in one way or another. Joint appointments and multiple collaborations in research, teaching, and communication of science aim at strengthening the bonds between museums and academia which are often understood as two discrete and distinct institutions having not much in common.

This paper aims at discussing the opportunities, challenges, and experiences with museum-university-collaborations by inspecting the German case. It raises a number of crucial questions related to both institutional and individual co-operation. Who is profiting from collaboration in what way? What are the gains, what are the costs of cooperating? How can museums strike a balance between supporting academic activities and ensuring institutional autonomy? What are best practice examples in the long run? What formats of collaboration have proved to be difficult, for what looks like an ideal fit of interest – a happy marriage in fact – on first sight often involves problems and tensions that result from the systemic differences between these two discrete types of institutionalized production and dissemination of knowledge, if one looks closer. The paper ends by placing the German experiences in an international context.

Rebekah HIGGITT | Royal Museums Greenwich, United Kingdom

History of science research and collaborations at the National Maritime Museum

This short presentation will briefly survey the extent and experience of collaborations with universities undertaken by the Science and Technology curators at the National Maritime Museum and Royal Observatory, Greenwich. This includes a successful research internship programme, a number of AHRC-funded Collaborative Doctoral Awards,

a large project grant shared with the University of Cambridge and forays into teaching at Masters level. I will discuss the benefits to academic research and to the Museum, highlight successful outcomes and examine areas in which problems can arise or improvements be made.

Alison HESS | Science Museum, London, United Kingdom

Studying 2LO: a case study of a CDA in the Science Museum

As part of the 'Museum-University Collaborations - an Ideal Marriage?' session I will be reflecting on my experience as an AHRC Collaborative Doctoral Award Holder with Royal Holloway, University of London and the Science Museum. Between 2008 and 2012 my PhD focused on the journey of the 2LO transmitter, the BBC's first radio transmitter, and a Science Museum object. As a student placed in both university geography department and museum, this project presented specific benefits and challenges around access and identity. In this session I will be exploring these issues and how they ultimately shaped the final the PhD thesis.

Kathleen McILVENNA | Institute of Historical Research, United Kingdom

United in history: a personal experience of collaborative research in museums and academia

In secured stores and fire-proof archives all over the country are a treasure trove of historical sources of which (gloved) academics have barely touched the surface. I am one of the lucky ones, and through a number of small projects, I have enjoyed opportunities to delve into museums stores and conduct research into this astounding national resource. Through my MA dissertation and a paid internship with the National Maritime Museum (NMM) I looked at sections of Submarine Telegraph cables. This not only took me into the NMM's stores but lead me to the Porthcurno Telegraph Museum in Cornwall, the Science Museum in South Kensington and the Freemason's Museum in central London. I have now embarked on a collaborative doctoral award with the British Postal Museum and Archive (BPMA) and the Institute of Historical Research (IHR) and am excited about the avenues the archives and collections of the BPMA may take me in the coming years. Though history and heritage are passions of both museums and university history departments, working with the two institutions require different skills and they can often expect different behaviours from their researchers. In this short paper I will look at the benefits and challenges I have experienced in these collaborative projects, arguing that there is a great deal of potential benefit to the students as well as to museums and academic scholarship.

Elizabeth HAINES | Royal Holloway, University of London, United Kingdom

Museum-university collaborations: an ideal marriage?

In October 2011 I began CDA research held jointly at the Geography Department, Royal Holloway, University of London and the Science Museum. The project investigates how aerial photography altered map-making in the context of British colonial Africa. My focus is very much on field practice and for this reason the collection of instruments at the Museum, and its institutional expertise in material culture is invaluable.

The benefits and disadvantages of these projects appear to me (as usual) to be two sides of the same coin. They are largely those of being in two places at once. The CDA has been an incredible opportunity to enjoy a very rich and diverse array of experiences, but this is set against the risk of feeling somewhat dissipated and jack-of-all-trades. This underlying concern carries right through the project, from grappling diverse literatures, to dealing with two communities of researchers, into constructing a thesis for a particular audience and on into future prospects.

There is no doubt that the 'doubling' of research arenas in a CDA means that I have a much higher degree of freedom in determining the direction and content of the project. This is an extraordinary opportunity and one for which I'm extremely grateful. I hope however that this panel might be able to consider how to better use the experience of past graduates to provide guidance for CDA students on how to navigate these choices soundly.

Pedro RAPOSO | CIUHCT - University of Lisbon, Portugal

Astronomy and the inner space: museum-observatories, the past lives of scientific sites, and historical research

My doctoral research (developed between 2007 and 2010) focused on the foundation and early history of the Astronomical Observatory of Lisbon (AOL), nowadays one of the University of Lisbon's heritage sites, and a splendidly preserved exemplar of a nineteenth-century astrometric observatory. My project was originally centred around instrumentation and its several meanings in the foundation and development of a national observatory (prior to its inclusion in the University in the early 1990s, the AOL functioned as Portugal's national observatory). Looking for a place where I could gain a broader perspective on such matters, I was fortunate to have my project accepted at Oxford and be supervised by Prof. Jim Bennett of the Oxford Museum of the History of Science (MSH). Prior to my Oxonian stay, I had worked at the AOL as an outreach officer, thus I knew well its magnificent spaces, where visitors can experience the ambience of nineteenth-century astronomical practice - with the old meridian instruments and clocks in place, inside a building designed to accommodate a sophisticated apparatus into an exquisite temple of science. MSH habitués are certainly familiar with the great astronomical instruments displayed in its main galleries, which include a mural quadrant, a zenith tube and a Herschel reflector. As soon as I started to wonder how scientific life used to be organized around these "detached" instruments I realized how helpful it was see the AOL instruments in their original settings. More than offering a wider insight on the apparatus, experiencing the spaces where historical instruments were formerly put into use provides important clues on several aspects concerning the codes, practices and routines that shaped the institutional life in which they were embedded. In the summer of 2008 I had the chance to complement my on-going research with an internship at the Royal Observatory, Greenwich (ROG), with a short-term project on the evolution of the ROG's buildings and their adaptation to scientific purposes. This was an enriching experience as the ROG sports finely preserved and/or reconstructed observing settings, and overall its complex of buildings and observing structures documents the evolution of the modern observatory qua spatial setting. Reflecting on these experiences and their impact in my doctoral research, I will briefly sketch some thoughts on (i) the preservation and reconstruction of historical observatories, (ii) their potential for historical research and graduate training, and (iii) universities' involvement in the development of such activities.

Commentary: Jean-Francois GAUVIN | Harvard University, United States

S002-B. Artefacts and beyond: multiple perspectives on material culture research

Tue 23 July, 11:10–12:40 • Uni Place 1.219

Session organiser: Helmuth TRISCHLER | Deutsches Museum, Germany

Chair: Helmuth TRISCHLER | Deutsches Museum, Germany

Artemis YAGOU | Deutsches Museum, Germany

Modernist complexity on a small scale: the Dandanah glass building blocks of 1920 as a case of object-based research

Technical (or Construction) toys originate from the world of engineering and machinery; they are inspired by the architectural and technological environment and developed on the basis of the opportunities these environments afford for play. This paper is based on research at the collection of technical toys of the Deutsches Museum, Munich, and focuses in particular on a rare and idiosyncratic as well as exciting object from the Museum's depot: the Dandanah set of building blocks, designed around 1920 and usually attributed to the architect Bruno Taut. The Dandanah consists of 62 blocks made of coloured glass, a material that was considered by Taut and others to be an expression of purity, innocence and hope; glass technology itself was often presented as a potential agent of change in construction and architecture. The fact that the Dandanah is included in the toy collection of a major technical museum emphasizes its playful as well as its technical character. However, the analysis of the artifact and its sociocultural context has revealed a much more complex picture that expands beyond technology and well beyond childhood and play. This paper situates Dandanah on the intersection of technical, utopian, educational and appropriation discourses, and foregrounds the complexity as well as the contradictions that this object incorporates. Furthermore, the present case-study triggers reflections on the wider role of this and similar artifacts within the context of a technology museum and discusses the potential and implications of object-based research.

Sybilla NIKOLW | Bielefeld University, Germany

The 'Museum of the Future' with new objects of knowledge: the case of the German Hygiene Museum in the twentieth century

In his much-regarded article on "Museums of the Future" from 1933 Otto Neurath took a stand against museums as spaces for the mummification of knowledge, where visitors are invited to marvel at the peculiarities of an era long past. Instead of studying the originals with expert eyes, he suggested, museum makers should adapt content and form of the displayed knowledge to the everyday world of the observer. His proposal aimed at the implementation of a new object culture in the museum. For Neurath that implied abandoning the traditional and disciplinary knowledge order for the benefit of contemporary and application-oriented presentations, in which objects were supposed to fulfil a dual task: in addition to conveying knowledge, practices and insights they acted at the same time as the very vehicle of communication. In Neurath's view this ideal had been realised in the new type of museums for technology, sociology and hygiene, in which he also included his Viennese Museum of Society and Economy with the Vienna Method of pictorial statistics (later known as Isotype). The characteristic features of these museums were the in-house production of their exhibits in proper workshops and their educational commitment. The latter was achieved with models, reconstructions, wall charts and demonstration apparatuses aimed to illustrate abstract and complicated procedures, and to make them understandable for the visitors. These were often asked to activate the exhibits themselves in order to convey the functionality of machines, social processes or the human body.

In my paper I use Neurath's to date canonical contribution to museum theory as a starting point to position historically the German Hygiene Museum founded in 1912 in Dresden. In keeping with Helmuth Trischler's positioning of the museum of technology I will interpret the foundation of this institution not only in the context of industrialisation processes but also as the product and force of the modern knowledge-based society at the turn of the century. Distinctive for this were, among other features, the scientification of the lifeworld as well as a close link between science and public. Here the orientation towards the present and application resulted in a celebration of the modern welfare state, and the development of innovative presentation techniques of the human body aimed at the instrument-based complete visualization of its

hazards, for instance, in physiological control devices or the so-called models of the transparent man. Following recent studies on historical object culture in the science museum I will discuss, how the reconstruction of exhibitions and object ensembles can contribute to a cultural history of the sciences in the twentieth century.

Liba TAUB | University of Cambridge, United Kingdom

The Whipple Museum MPhil essay model for research projects

Speaking at the launch of the Science Museum's new Research and Public History Department, Ludmilla Jordanova offered insights that resonate with many of us trained in history of science, especially those concerned with collections of historical scientific material:

'I was mainly taught about abstract ideas; now it is taken as read that embodied knowledge, material and visual culture, and the close analysis of social practices are central to our field. But we must confess that the *full* potential of integrating museum collections and the expertise of museum professionals into academic understanding is yet to be realised'.

And, while academic historians of science are increasingly acknowledging the importance of material and visual culture, few have had opportunities to work on such material first-hand, within a museum. At the same time, in many museums object-based research is now something of a luxury; curators are often too busy with other important tasks to study objects in their care. Collections-based research is done on the fly, meeting deadlines for exhibitions or performance indicators.

The Whipple Museum of the History of Science, part of the Department of History and Philosophy of Science at the University of Cambridge, has over many years been the base of a remarkably rich and varied research output, communicated to a range of audiences via a number of formats. This research has been conducted largely by students (undergraduate, MPhil and PhD). In particular, the MPhil essay (5000 words, produced in about 6-7 weeks) has provided a wonderful template for enabling original object-based research to be undertaken in a form that can be shared readily with others. An impressive number of MPhil essays on objects held in the Whipple have resulted in publications, often taking the form of studies of the 'lives' or 'careers' of scientific objects (cf. Alberti, "Objects and the Museum," *Isis* 2005, 96:559-71); this research is accessible on the *Explore* website (hps.cam.ac.uk/whipple/explore) and in the galleries. Usually, students have no prior experience of working with material culture, yet produce excellent work of broad benefit.

Adopting the MPhil essay model for tightly-focused research projects, museums could offer internal staff, external students and academics 6-week opportunities to study objects in their collections; such projects would benefit all concerned. Examples from the Whipple, with specific recommendations for implementation will be offered.

Martin COLLINS | Smithsonian Institution, United States

No ideas but in things: the material turn, museums, and academia

In 1927, poet William Carlos Williams summarized the poetic task as "no ideas but in things." One might take his proclamation as insight into recent decades of humanities scholarship, in which material culture has become an important organizing analytic, including for history, generally, and especially in history of science and technology. In the latter, this turn has conjoined research perspectives, primarily, from STS studies and anthropology to understand knowledge production and cultural change in highly local contexts as well as at the level of the nation and the transnational. The core of this turn is the notion that "stuff" has agency (in some fashion) and participates fundamentally in shaping historical orders. Most important for this session, though, is that such perspectives have broadened the conversation between museums and academia on the status of "stuff" in historical narrative and explanation, elevating the perceived value of collecting and exhibition in intellectual life. This paper will explore the contours and opportunities of these developments.

S002-C. Using the Web and social media to extend the traditional aims of museums

Tue 23 July, 14:10–15:40 • Uni Place 1.219

Session organisers:

Martin COLLINS | Smithsonian Institution, United States

Tim BOON | Science Museum, London, United Kingdom

Chair: Martin COLLINS | Smithsonian Institution, United States

Alexander BADENOCH | Université Paris IV Sorbonne, France

Curator 2.0? Rethinking collectors and collecting in Inventing Europe

The age of digital heritage offers new opportunities - as well as new challenges - for attempting to cross these boundaries and rethink both European history as well as museum collections. The large push to create a smooth space European space of digital heritage - itself a project of technological harmonization - makes connecting objects and collections supposedly easier than ever, but also seems to elide the work of adaptation and interpretation involved in such projects. As 'objects' are increasingly what comes into circulation, the status of 'collections' becomes more embattled. How can national, local, or 'universal' collections tell European stories? These challenges lie at the heart of Inventing Europe (www.inventingeurope.eu), an online virtual exhibition developed connection with the forthcoming six-part book series Making Europe: Technology and Transformations 1850-2000. Inventing Europe works in partnership with a consortium of cultural heritage institutions throughout Europe, especially science and technology museums, but also media archives, and local and national history museums. The images, sounds and videos borrowed from the collection, plus a large and growing number of linked items allow users to make new connections between the stories here and the rich and growing online collections of museums, archives and libraries, including the European digital library Europeana. The exhibition is conceived of as a flexible platform that allows each set of stakeholders (researchers, heritage partners and educators) to inscribe their own forms of knowledge within it and structure their interactions with the other groups. In so doing, the project is also designed to place collection objects in the centre of new forms of public dialogue. This paper will focus on the role of the (online) curator as mediator of collection knowledge. It will explore the communicative processes surrounding objects, as well as the tensions between objects and narratives that emerge. It will then explore the potential communicative power of collections (and the work of curation). It will look at a series of 'guest curated' elements, where curators from participating institutions were asked to interpret a series of objects from their own collection in terms of the transnational remit of the exhibit.

Karin TYBJERG | Medical Museion, University of Copenhagen, Denmark

Understanding social media in STEM museums: the lessons from establishing a bio-hacking laboratory

Medical Museion at the University of Copenhagen is both a research department in medical science studies and a museum with large collections and outreach activities in the form of exhibitions, events and web communication. The research and the public engagement are tied together both through a focus on materiality, an interest in participatory public activities and through an extensive social media dimension (twitter, Facebook, blog etc.) The museum is currently building a DIY biology (or 'biohacker') space inviting another form of public science to

be part of the museum. The biohacking movement is a citizen science "maker-culture", where personal engagement in the materiality of the physical objects and processes is central. At the same time it is a global movement, where communication on social media forms a close community. The construction of the biohacker laboratory builds on and sustains the museum's focus on combining interaction with physical objects and social media activities. This experience led us to ask if a conceptual link can be established between curating material things and being on social media? And whether social media fulfill the democratizing and publicizing ambitions of the hacker movement and the museum or simply become part of the long tail of specialized communities.

This presentation is based on work co-authored by Thomas Söderqvist.

Robert BUD | Science Museum, London, United Kingdom

Multimedia as an art form for communicating the history of science

The emphasis in treatments of the use of multimedia in scholarship has been on the value for research. Drawing on the experience of the Science Museum in London, this paper will argue that there is also a serious scholarly challenge in its application in such a way as to use fully the communicative power of the medium. The challenge of combining education and pleasure through the integration of multiple media is a serious opportunity for historians as well as for designers who have hitherto been allowed to take the lead in this genre.

S002-D. Developing a public history of science, technology and medicine

Tue 23 July, 16:10–17:40 • Uni Place 1.219

Chair: Rebekah HIGGITT | Royal Museums Greenwich, United Kingdom

Tim BOON | Science Museum, London, United Kingdom

Adventures in the public history of science

Introducing the session, I want to open up some questions about the public culture of science in the past and the present that we can expect to be echoed later. The Science Museum's public history programme is an enterprise that seeks to bring together research into the public culture of science in the past and the present, asking questions about how lay people think about, understand and incorporate ways of thinking about science, and the part that science's past plays in these modes of thought. Some aspects of this research programme are historical analyses of the media by which the public have encountered science in the past, such as science on television and in museum displays. Others have been co-production experiments, kinds of research through practice in which lay people have been enrolled in projects that enable them to articulate their sense of the past of science and technology and its relation to their broader historical sense. Examples include projects on the history of electronic music and with family and local historians. In reflecting on the work so far, I aim to begin to draw some historiographical insights and to prompt further questions for investigation.

Hilary GEOGHEGAN | University College London, United Kingdom

Enthusiasm for science and technology: from lay historical subject enthusiasts to citizen scientists

Enthusiasm is an emotional affiliation to an interest, cause or activity that influences actions, passions and performances in space. This paper explores what it means to have an enthusiasm for science and technology through examples of collecting, hoarding and tinkering with obsolete technologies, as well as counting, monitoring and recording wetlands birds and trees. Bringing together the fields of public history

and citizen science, this paper identifies some of the ways in which these long-standing fields might work together in museums.

Jack KIRBY | Museum of Science and Industry, Manchester, United Kingdom

Changing times: non-specialist audiences and the interpretation of historical technology

Non-specialist adult audiences with little or no traditional understanding of historical science and technology can nevertheless feel affinity with artefacts in museum collections. This paper will consider how personal frames of reference influence both the interpretations of artefacts and values placed upon them by individuals, the extent to which these may differ from the interpretations and values accorded by curators and historians of science and technology, and the implications for curatorial and interpretative practice in museums seeking to engage these audiences. Examples will be drawn principally from a case study of a participation project in which non-traditional audiences worked to select and interpret artefacts for an exhibition.

Keynote

Ludmilla JORDANOVA | King's College London, United Kingdom

Difficult issues: artefacts, museums and the public history of science, technology and medicine

The role of research in museums is a complex one, and science museums are no exception. This category of museum does raise a number of distinctive issues, however. If science museums are construed as primarily for children, "research" in the sense that historians of science, medicine, and technology (STM) understand it, plays a minimal part. But if, as many of us believe, science museums must engage with adults, and in sophisticated ways, the question remains how to bring to our professional understanding to non-specialist audiences through objects, images and displays. Around the world many attempts to do this have been made, but the question needs, nonetheless, to be asked repeatedly, and it is this question my plenary will address. I will argue that in order to bring forth the materiality of practices associated with STM, we need to address a number of difficult conceptual-cum-political issues. These include the ways in which abstract matters can be communicated through artefacts, and by "abstract matters" I mean to include both historical analysis and the object of that analysis - science, medicine and technology. We can usefully construe this presentation to wide audiences in science museums as a form of public history. But this notion too needs requires careful conceptualisation, which must include a discussion of the inflections of "public" that will, at least in part, be driven by local political circumstances. Furthermore, public history is now a big issue in countries such as Australia, Canada and the United States, and those concerned with STM form only a small section of the communities that produce and debate it. These are matters of considerable importance not just for historians of STM but for those who run, and indeed care about, science museums and the well-being of their staff.

S003. Historical development, contemporary investigations and perspectives of the logical and philosophical foundations of science, technology and medicine

Sat 27 July, 09:00–15:30 ▪ Roscoe 1.009

Symposium organisers:

Peeter MÜÜRSEPP | Tallinn University of Technology, Estonia
Boris CHENDOV (non-participant) | Independent scholar, Bulgaria

Don FAUST (non-participant) | Northern Michigan University, United States

Symposium abstract

The creation as well as the dissemination and deployment of scientific knowledge is based chiefly on experience and logic, besides an essential role plays also the philosophical approach to empirical research and to logical treatment of empirical data. The symposium S003 is intended to elucidate on an interdisciplinary level those aspects of "Knowledge at Work", which are expressed in the logical and philosophical foundations of science combining historical investigations, current theoretical research and methodological prognoses and prescriptions to its further development. In accordance with such an intention the speakers are encouraged in their papers (1) to use their scrutiny of the history of given field of science for elucidation of present theoretical activities (2) to apply the information about recent theoretical investigations – proper as well as of other scientists, for new interpretation of the historical development of corresponding problems and ideas in the past, (3) to make methodological conclusion from both the history of science and the recent theoretical investigations about the approach to further theoretical investigations in the given field of science or merely of given scientific problem outlining the perspectives of its further development. In the same time the participants of the Symposium are encouraged in their papers and discussions to follow the interdisciplinary approach, in particular to combine problems, ideas and methods of logic, philosophy of science, history of science, mathematics, natural sciences, technology and medicine, to pay attention to their common places. Correspondingly, the Symposium is intended in the course of presentation of papers and of their discussion to unify the efforts of specialists from different spheres of the human knowledge: (1*) historians of science, technology and medicine showing interest also (1*.1) to logical and philosophical aspects of their studies as well as (1*.2) to problems of the history of logical and philosophical foundations of respective field of science, technology, medicine; (2*) logicians and philosophers working on the foundations of sciences, technology, medicine, and in the same time paying attention to the historical aspects of their research; (3*) specialists of various fields of sciences, technology and medicine, paying attention to the logical, philosophical and historical aspects of their research; (4*) scholars working in the field of interdisciplinary problems.

The programme of present symposium naturally don't exhaust its subject formulated above by means of its title. But its organisers hope the execution of this programme in the course of its work to be not merely one day event however an essential step in the process directed to more complete treatment of the given subject and they recommend the participants to have in mind this perspective during discussion of presented papers.

S003-A. The logical foundations of scientific knowledge

Sat 27 July, 09:00–10:30 ▪ Roscoe 1.009

Chair: Raffaele PISANO | Université Lille 1: Sciences et Technologies, France

Arto MUTANEN | Finnish National Defence University, Finland

General methodology: logic of discovery and justification

In the 1960's the problem of scientific discovery became a topic that has been under interest of the philosophers of science. The basic idea is to study the whole dynamic process of scientific reasoning. There are several different approaches that focus the attention to the problematic. In the following we will consider the dynamics of scientific inquiry analysing inquiry as a questioning process. The questioning approach has deep historical roots starting from Socratic method of questioning. Inquiry as a questioning process has to be analyzed as a strategic process in which the logic of inquiry is based on the logic of questions and answers. The questioning process is a strategic, goal-directed process. Evaluations of the questioning processes are done on the level of strategy. So, the goodness of the steps in the whole questioning process is evaluated only relative to the whole strategy. The central idea is to characterize scientific reasoning as an ampliative process in which the ampliativity is the property of the whole process not of any singular step; especially the ampliativity is not a property of underlying logic. So, the usual Humean induction does not play the central role in reasoning by questioning. The questions are addressed to some outer source of information. The reliability of the sources of information is the central property. If the sources of information are known to be reliable then the results inferred are also known to be true. In this case the resulting logic can be characterized as a pure logic of discovery. On the other hand, if the sources of information are known to be unreliable then we have to develop a logic in which the forthcoming answers should be evaluated. Some of the answers may be rejected and later accepted. The operators of rejecting and accepting make the whole process more complicated but at the same more realistic. For example, this allows us to develop a logic of justification. The fundamental aspect in this logic of justification is to handle the probability of the forthcoming information. To develop the more general logic of discovery we have to develop the method of analyzing the epistemic power of different interrogative processes that give the same result. The notion of interrogative independence plays the central role here. That is called the consilience of induction by Whewell.

Valentin A. BAZHANOV | Ulyanovsk State University, Russia

Russian forerunners of alternative logics: the philosophical background and connections with the development of scientific knowledge

The starting point of the path to alternative logics can be found in vague sensations related to the feelings of imperfection of the classical logic and of Aristotelian logic laws. Intense fermentation of logical minds in early XX century Russia created the milieu favorable for the birth of the new type of logics. 1. Due to pretty tight ties with the Western Universities Russian scholars knew well and followed novel trends in logic. However the Russian logical thought developed to large extent along the original lines. In 1901 – 1902 S.O.Shatunovskii argued that the law of excluded middle is not applicative to the infinite sets. In the book "The Pillar and Affirmation of Truth" (1914) Father P. Florenskii implicitly meant the idea of paraconsistency. Gleam paraconsistency ideas may be detected in the works of A.I.Vvedenskii and N.O.Loskii (1909 - 1917), but the true history of paraconsistent logic emerged due to construction of imaginary logic by N.A.Vasiliev (1910 - 1914). 2. What vague and barely formulated analogies fed Vasiliev's pioneer work? They are: C.S.Peirce's logic of relatives; the symbolist poetry that paid a great deal of attention to the subject of another worlds; special psychological standpoint, used for the critical analysis of Aristotelian logic; Ch.Darwin's ideas on the evolution of life; the analogy with non-Euclidean geometry construction method. 3. Intellectual climate prior to Vasiliev's works supposed only the abstract possibility of non-Aristotelian logic, the notion of which related to the analogy of non-Euclidean geometry. He even claimed that imaginary logic is constructed by Lobachevskii geometry method. 4. In his imaginary logic Vasiliev discarded fundamental law of Aristotelian logic - the law of contradiction and proposed system free of this law. He argued that the law of excluded middle ought to be completely removed from the "canons of the laws of thought" as well. Nevertheless, in any logic there are laws enabling the reasoning. The minimum of such laws constitute a

metalogic - the science of structures valid for every logical system. 5. In early 1920 the phenomenon of ideologized science emerged in the USSR which has negative impact upon Soviet science. Nevertheless, this phenomenon induced original by-product in logic. I.E.Orlov shared orthodox Marxist standpoint and pursued strict dialectical style reasoning. He has goal to construct dialectical logic for natural sciences development that would coincide with the theory of knowledge and objective dialectics. All his numerous philosophical works are done in Hegel's tradition full of critique of bourgeois ideology. These papers were published in leading Soviet Marxist journals. The only paper devoid of any Marxist (and philosophical) content "The calculus of Propositional Consistency" was published in 1928 in one of Soviet mathematical journals. In this paper Orlov attempted to overcome the paradox of material implication and to move from the "logic of extent" to the "logic of content". This paper happened to opened modern relevant and substructural logics, and anticipated O.Becker's 1930 and K.Godel's 1933 papers for it contained construction of S4 system. Work partly supported by RBRF grant.

Fátima MASOT-CONDE | University of Seville, Spain

Understanding Einstein's viewpoint on the philosophical foundations of quantum mechanics

Due to its experimental success, Einstein's battle against Quantum Mechanics is seemingly lost. However, the acceptance that Nature can be random at the moment of measurement brings a strange implication on the character of Nature, being undetermined at the measurement moment, while keeping determined *before* and *after* it [1]. If real, this selective undetermination would represent either an inconsistency of Nature itself (since the act of measurement is not special, just another physical interaction), or more probably, the inconsistency of our system of understanding it (Science). In both cases, the consequence is fatal for our endeavour of searching reasonable causes thereafter, either if the world is essentially random and there are not such reasonable causes, or if our system of understanding is constructed under that premise.

Einstein's world, instead, is comprehensible, and that is the basis of my defence of his point of view. Science is not a historical accident, it did not arise by chance, but as a consequence of the intelligent nature of the human being. The human being, as an intelligent one, needs to understand, *even if the world is not understandable*. The reason is the basis of our scientific search, and the belief that there is something understandable behind any natural phenomenon is the motor of its progress. Rather and beyond the determinism implied by Einstein's view, it is the comprehensibility premise which is fundamental for Science. Otherwise, our scientific endeavour in search of understandable causes dramatically collapses in the absurd, when we accept that the world is essentially random and that there are no such understandable causes to be looked for.

Recent experimental results, though, have confirmed the existence of pure random atomic jumps induced by measurement, revealing a Universe more unattainable and incomprehensible of what we expected [2-3]. Faced with this dilemma, I still would incline the balance to the side of comprehensibility, which drives/condemns us to an everlasting search of a more and more subtle causality underneath the apparent quantum randomness.

1. R. PENROSE, "The Emperor's New Mind", Oxford Univ. Press., 1990.
2. J. S. BELL, "Speakable and Unspeakable in Quantum Mechanics", Cambridge University Press, 1987.
3. K. GOTTFRIED, "Does Quantum Mechanics carry the seeds of its own destruction", Physics World, pp. 34-40, October, 1991.

Alain ULAZIA | Euskal Herriko Unibertsitatea, Spain

The role of analogy in the genesis of Bernoulli's theorem

When the scientists wanted to found fluid dynamics some heuristic problems were encountered. There were not physically isolated material

particles as it was usual in order to apply Newtonian dynamics, and the fluid's own lack of form and its capacity of spatial extensibility needed an imagery that orthodox Newtonian problems did not offer. As a result, in the starting point of the theoretical genesis analogy was more than just associative relation with expedient function, analogy should be able to activate and contain inside new image schemas and to regenerate the imagery needed for the solution of fluid dynamics problems. Bernoulli father and son were committed to this, especially the son.

The explanation and the determination of velocity-pressure relationship was the best contribution made by Daniel Bernoulli to the history of fluid mechanics. In the introduction of the chapter XII of his work *Hydrodynamica* says that the pressure of static water and the pressure of the flux of water must be clearly distinguished. Here he realized, "surprisingly", that the pressure cannot be defined without taking into account the velocity of the flow.

Daniel presents a thought experiment based on a standard problem in order to investigate the pressure-velocity relation. The thought experiment is used within analogical reasoning with a creative function: to generate predictions for the flow phenomenon in a pipe (target) and to generate ideas for constructing model. Besides this, related with images, there is an imagery enhancement by generating extreme cases that helps tap implicit knowledge by increasing the contrast between simulations. The use of extreme cases, which seeks this contrast, is one of the clear heuristics instruments in the design of simulation; but there is another: the use of the cap with the hole as a heuristic marker to make it easier to track changes in key variables as pressure and velocity. All this simulative process establishes a source of conviction for the thinker because it is a way of generating an initial plausibility test for the model. There is a evaluation via simulation, as in the case of Maxwell's electromagnetic wheels and gears described by Nersessian (2002). Later, the conviction obtained for this qualitative model was able to develop a quantitative mathematical model to reach the famous Bernoulli's Theorem.

S003-B. Epistemological and ontological aspects of scientific knowledge

Sat 27 July, 11:00–12:30 ▪ Roscoe 1.009

Chair: Dalong Lu | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Peeter MÜRSEPP | Tallinn University of Technology, Estonia

The historical roots and recent developments of self-organizational thinking in physics and chemistry

The historical start of self-organizational thinking can be traced back to Aristotle's four cause theory. The Stagirite did not limit his understanding of the world to the material, formal and efficient causes but was ingenious enough to stress the importance of the final goal, final condition of any process that is not a stagnated state but rather a dynamic situation of openness to self-organization. The Aristotelian approach to the understanding of the world was suppressed at the dawn of modern science by Francis Bacon and René Descartes. Isaac Newton seemed to follow the newly established tradition. We must not forget, however, that Newton was not a seeker for scientific knowledge in the narrow sense. His real aspiration was directed to creating a holistic picture of physical reality. That's why he called his main treatise 'Natural Philosophy'. It was Newton who initiated an active experimental dialogue with nature that developed into self-organizational thinking in modern science. The next important step was taken by the so-called philosophers of the Enlightenment who were not happy with the concentration of scientific research on stable systems and neglecting attention to developing structures, including everything connected with life. The term

'self-organization', however, came into use only after World War II. It was coined by the psychiatrist and engineer W. Ross Ashby. It became associated with cybernetics until Ilya Prigogine gave it a whole new meaning. Attention was shifted from cybernetics to thermodynamics. It was Prigogine who made the idea of self-organization the core of his new approach to science, first in chemistry and physics, when in social science as well. Prigogine's approach to science, based on self-organization theory was taken as revolutionary by some philosophers of science. At the same time, he has been severely criticised by many. Today, it is a normal part of our thinking as scientists that there are self-organizing systems all around us. It may well be that the essence of the Prigoginian "revolution" has not been fully understood yet. We are witnessing new attempts to achieve a united understanding of the human matters on the basis of science. Nicholas Maxwell is even speaking about the need for a "New" Enlightenment. Thus, the idea of self-organization deserves taking a fresh look at.

Leo NÄPINEN | Tallinn University of Technology, Estonia

The problem of the understanding of nature in the exact sciences

The usual opinion among many scientists and science-based educators, developing and teaching logical, mathematical and scientific methods is that the exact science deals with the understanding of nature. I defend the conviction that the exact science does not deal with and must not deal with the understanding of nature (*physis*), because exact scientists themselves construct their objects of investigation, which are idealizations, not the reality itself. In the exact science an object must be adapted to *a priori* cognition and the aim of the scientist in the physical-mathematical sciences is discovering the 'laws of nature' (objective or scientific laws formulated mathematically and confirmed experimentally or quasi-experimentally), getting the true picture about the real phenomena does not belong to this aim. We must understand that the exact science has its *premises* and *limits* which come from the preconditions and specific character of the exact science. The exact science deals with idealizations only and because of that cannot grasp the reality in all its complexity and diversity. And it is normal for the exact science. But to avoid the misunderstanding or even the myth about science we must understand how and why these idealizations have been created and under which conditions they are valid. We must not take them as the foundation of reality on which all the objectively existing rests. The reality is inexhaustible and there are many real, not illusory aspects that do not result from this foundation and are not in accordance with it. The exact science cannot move further than the idealizations. The understanding of the real world "as it is" is possible only beyond the idealizations. We all know from our experience of living in everyday world, that such characteristics of nature and human society as instability, chance, irreversibility, unpredictability, historical time, emergence of novel appearances, etc. are real, not illusory. The scientists in the physical-mathematical sciences must not eliminate the phenomena the model had no need to take into account. These phenomena have to be indicated and understood outside the exact science (beyond the idealizations). Therefore, the way to the understanding of nature (and human society) for scientists lies in the co-operation between the exact science and the non-exact sciences (from classical biology to humanities).

Raffaele PISANO | Université Lille 1: Sciences et Technologies, France

The culture of machines in the sixteenth and seventeenth centuries: a bridge between machineries and conceptual frameworks

A historical and epistemological features on the role played by machines and machineries in the 16th century—during Tartaglia's time are provided. In order to offer a standpoint regarding the new scientific interest of science at that time for the development of practical science around machines and machineries a compound analyses among

foundations of mechanical science, concept of applied science, machines and examples of machineries are presented. Particularly, a) the science recognized as science at that time is briefly reported to be correlated with the knowledge of the non scientist men as builders, architects, engineering. Usually a discussion concerning history of science and technique/technology is presented such as a discipline within the history of science for understanding eventual relationship between science and the development of art crafts produced by non-recognized scientists in a certain historical time.[1] Thus most offer interesting outlooks of analysis within a predominant paradigm—key of investigation Nevertheless, an *a priori* relationship between science and technique/technology is hypnotized, e.g.: a) Presenting mechanics and mechanism and then the general importance of machines. *The study is within science and technique as unique technical paradigm of investigation.* b) Presenting philosophy of mechanic-ism to explain traditions, heritage and aims. *The study is within philosophy as unique paradigm of investigation.* c) Presenting the role played by religions to explain traditions, heritage and aims. *The study is within philosophy as unique paradigm of investigation.* d) Presenting the rationalism of ancient writings as having remarkable impact on Renaissance scholars. *The study is within humanism philosophy as unique paradigm of investigation.* On my side a historical–epistemological analysis related with eventual, (*how and when*) use of science (physics, mathematics and geometry) worked with machines and machineries would be presented. A main question is: *when and why the tension between science (physics, mathematics and geometry) gave rise to a new scientific approach to applied discipline such as studies on machines and machineries during 16th century* The foundations are the main key of investigation of current science at that time, so will start from science at that time to investigate both the role played by theoretical and conceptual frameworks by means of the eventual bridge between science and techniques/technologies within machines and machineries. *In that sense what kind of science was (if) used for projecting machines and machineries?*

S003-C. Logical and philosophical aspects of the foundations of ancient and modern scientific knowledge

Sat 27 July, 14:00–15:30 ▪ Roscoe 1.009

Chair: Arto MUTANEN | Finnish National Defence University, Finland

Dalong Lu | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Preliminary analysis of the logical construction of the calendars of the Qing Dynasty

In the early period of the Qing Dynasty (1644-1911), The four calendars had been put into use, *Xiyang Xinfu Lishu* (Treatise on Mathematics (Astronomy and Calendrical Science) according to the Western method, issued in the Ming (1635) as *Chongzhen reign-period Treatise on (Astronomy and) Calendrical Science*, reissued and revised as the former by Johann Adam Schall von Bell (1591-1666) in 1645, 1628-1827, and the year of 1628 was selected as the epoch of the Calendar), *Kangxi Yongnian Lifa* (The Eternal Calendar of Kangxi Emperor, compiled by Ferdinand Verbiest (1623-1688) in 1669, 1828-3827), *Yuzhi Lixiang Kaocheng* (Complete Studies on Astronomy and Calendar, 1725, 1684-1983) and *Yuzhi Lixiang Kaocheng Houbian* (The Supplement to Complete Studies on Astronomy and Calendar, 1742, 1723-2022).

The Calendrical Book of Eclipses (Jiaoshi Lishu), compiled by Ferdinand Verbiest in 1683 and was of historic significance in the development of the Chinese Calendars in Qing Dynasty, has not been meticulously investigated upon to now, in which the obliquity of the Ecliptic of 23°32', as the corresponding values of Profatius (c.1236-1305, Ibn Tibbon, Jacob ben Machir), was applied in Tables of Ninety Degrees of the

Ecliptic and otherwise 23°30' (Er shi san du ban) was permuted in Tables of the Solar Height. Furthermore, the methods of calculation and permutation in Tables of the Solar Height, of which the errors in 4', developed and expanded as Tables of the Solar Altitude in *Yuzhi Lixiang Kaocheng*, in which the obliquity of the Ecliptic is of 23°29'30", is realized as a bridge for the continuity of the calendars in Qing Dynasty.

Introduction to, theories for and mathematical principles of calendrical science have been gradually interpreted in *Xiyang Xinfu Lishu*, *Yuzhi Lixiang Kaocheng* and *Yuzhi Lixiang Kaocheng Houbian*, and the Jesuit and Chinese astronomers had compiled the Calendars of Qing Dynasty in completeness and perfection.

The author gratefully acknowledges the support of

National Science Foundation of China (NSFC), K. C. Wong Education Foundation, CAS, and the China-Portugal Center for the History of Sciences (CPCHS)

YAO Dazhi | Institute for the History of Natural Science, Chinese Academy of Sciences, China

On transforming the narrative of the history of technology in China from a global perspective

When a historian is involved in writing a world history of technology, he or she has to harmonize narratives of China and of the West, or to embed the Chinese historical achievements into the framework of world history of technology, because of the tension between narratives of China-centrism and of Western centrism.

In *History of Techniques* written by Bertrand Gille, French historian of technology and winner of the Leonardo da Vinci Medal in 1970, on the one hand, there was a parallel development of technology in ancient China and in the West, and on the other hand, China was identified as the Other, or had an image which was different from the West. Ancient China is indeed embedded into the course of global technological development in an appropriate way. The very fact is that the tension between historical narratives of the West and of China is released. How does he perform the task?

Gille tried to construct a framework of world history based on his approach of technical system. In a sense, his framework of global technological evolution is a typical example of Western-centered history. The hard core of conventional historical narrative of Chinese technology is based on conventional historical viewpoints and Chinese centrism. There is a tension between his framework of world history and the narrative of China-centered history.

For the sake of the perfection of framework of world history, Gille argued against conventional notions of history of technology in China, reshaped historical facts, and introduced alternative notions in order to avoid conflicting with the framework of world technical evolution. First of all, he doubted and reshaped historical facts. From a perspective of technical system, he suspected the truth that some great technologies originated in China, such as typography, gunpowder and the compass. Secondly, Gille substituted technological concomitant evolution and technological interchange for technology transferring. Thirdly, Gille directly argued against the advancement of ancient China over the West, and suggested that China and the West had been at exactly the same stage from the paleolith period to the Renaissance.

During his transformation of conventional China-centered narrative, Gille tried to make Chinese civilization "the Other". In the reference frame of global technical evolution, or by comparison, the Western civilization has shown its superiority in many fields from the 15th century onwards, and the technological development of non-Western civilizations should be regarded as an experience of failure. Gille asked why ancient Chinese technical development had been blocked in the 15th and 16th centuries. He introduced the notion of "blocked system" to describe such a phenomenon and gave some specific reasons to explain this historical phenomenon.

Despite Gille made his conclusions concerning the blockage without sufficient evidence, his question is still valid to some extent. The technical evolution and the blockage of technical system are two sides of

a coin. One of Gille's aims in *History of Techniques* is to establish a framework of global technical evolution that is characterized by the Western-centrism. In this framework, a Non-Western civilization, as "the Other", inevitably became a blocked system sometime at the dawn of the modern age.

In order to embed the technological development of ancient China into the picture of global technical evolution, Gille reevaluated the overall level of ancient Chinese technological development, suspected Chinese great inventions, and opposed the historical trend of unidirectional technological transference. After the out-dated notions were abandoned and those important historical facts were reshaped, the conventional historical narrative of Chinese technology was erased in Gille's text to some extent. The technological advancement of ancient China was regarded as an illusion. From the Christian era to the 15th century, Chinese technology was not more advanced than that of the West. The stagnation of Chinese technological development stood out at a certain time. In this way, China was successfully embedded into the framework of global technological development.

Yulia CHUKOVA | Krasnopresnenskiy Ecological Fund, Russia

Chinese medicine as a part of Chinese philosophy, and western medicine as a place for the use of scientific advances: perspectives and problems

In the history of our civilization there is one big riddle connected with independent existence of Orient (Chinese) and Western (European) medicines during two millenniums. This independence arose in that times, when China was artificially divided from the rest of world. Now in the period of globalization all artificial boundaries fell, and striking independence of European medicine and Chinese medicine becomes a subject of discussion. At 13th International Congress of Logic, Methodology and Philosophy of Science (2007, Beijing, China) for the first time there was the Special Symposium "Chinese Tradition medicine vs. Western Medicine".

Now there is the method which allows to make a bridge from Western science to tradition Chinese medicine (TCM). This bridge is given by new branch of thermodynamics, namely, irreversible thermodynamics of physiological processes under electromagnetic radiation [Chukova Yu.P. *Advances in nonequilibrium thermodynamics of systems under electromagnetic radiation. Khristostom, Moscow, 2001, ISBN 5-7508-9285-X*]. This new science can be a dictionary for translation of terminology of Chinese medicine in language of Western science.

The modern understanding of a place of the Chinese and Western medicine in an overall picture of modern natural sciences is given; ways of their logical bringing together are been shown. Problems and public health services prospects are analyzed for the near future.

Saeed SEYED AGHA BANIHASHEMI | School of International Relations, Iran

How history of science can help new technology

In this article we try to show how history of science can help new science in this way history of science can give more value to history of science much as before. In this article as example we show how history of mathematics especially history of cryptology can help science of cryptology. In first part of article I show the root of cryptology by mathematical manuscripts which show where and when first academy of cryptology started then by examples we show old algorithms and mixing with new algorithms like DES, tow fish, ...and so on this can make a revolution in new look to history of science.

S004. Colonial science at work

Sat 27 July, 09:00–10:30 • Uni Place 2.218

Symposium organisers:

Pratik CHAKRABARTI | University of Kent, United Kingdom

Deepak KUMAR | Jawaharlal Nehru University, India

Symposium abstract

This panel will take a fresh look at the theme of Science and Colonialism with an attempt at understanding the complex intertwinement between science and the economic and administrative purposes of colonialism. Science and imperialism have been debated widely in recent years, and historians have highlighted the various eclectic and innovative processes that shaped scientific ideas and research in the colonies. This panel will investigate the various ideological and intellectual premises that defined science's role in the colonial development projects and the role science played in establishing colonial governance in sectors like agriculture, veterinary medicine, purification of water and in the general ideas of colonial development in Asia and Africa.

Chair: Deepak KUMAR | Jawaharlal Nehru University, India

Sabine CLARKE | University of York, United Kingdom

Reflections on the historiography of science and development

The ideas and practices of development have been subject to much scholarly attention and an increasingly detailed picture has emerged of development interventions in the past. Informed by the work of James Scott, James Ferguson and others, development is often described as a regime - an all encompassing form of state power which is intrusive, transformative, disruptive, simplifying, hubristic and often ultimately futile. The role of experts (as they are almost always known in this literature) is often said to have been to legitimise these state interventions. For scholars the exemplar of the development project of the twentieth century is the large-scale African agricultural scheme. The aim of this paper is to raise some questions about our understanding of the development projects of the past. The first concerns the focus on agricultural projects that occurred in rural Africa. There has been a real concentration of scholarly attention on this particular type of development project and arguably it is the characteristics of these type of projects that have come to define the nature of development in the existing literature. However, Havinden and Meredith show British funding for development between 1945 and 1970 privileged social projects, such as education and water schemes, followed by communications projects such as road building. But where are our historical accounts of road and school building, of new airports and harbours, of water and sanitation projects in the British colonies? To what extent is it valid to take agricultural schemes as representative of a development ethos of the mid-twentieth century, since they were one category of project amongst many at this point? Additionally, why is it so often Africa that is the focus of attention? This paper will show how a study of development plans for the Caribbean region reveals some important and overlooked features of development after 1940. Development was a more diverse set of ideas and practices than some accounts led us to believe for reasons which will be explored here. Finally, this paper will argue that the term 'expert' is unhelpful in creating sophisticated literature on science and development since the twentieth century saw increasing diversity in technical personnel in the tropics, in terms of educational achievement, speciality and function.

Pratik CHAKRABARTI | University of Kent, United Kingdom

The science of water in colonial India

The paper will explore how investigations of purity of water, both of natural sources and in the municipality reservoirs in urban centres was a key project in public health policies as well as in the application of chemistry and bacteriology in colonial India. By the nineteenth century, through repeated outbreaks of cholera and other water related diseases, water resources in India had become a topic of intense discussion and debate among colonial medical officers and administrators by the

nineteenth century, with the setting up of the municipalities, the supply of clean water for urban areas had also become an important concern in India. The paper will explore how the sciences of investigation of the purity of the natural water resources and the technologies adopted to purify water and supply clean and piped water in India developed in conjunction with changing ideas of tropical climate and environment as well as with the adoption of new scientific methods.

Saurabh MISHRA | University of Sheffield, United Kingdom

Ticks, germs and cattle disease: colonial scientists and bacteriological research, 1900-1930

This paper will look at the developments with respect to laboratory science in colonial India in the period between 1890 and 1920, focusing mainly on the experimentation with regard to animal diseases such as rinderpest and surra. In this connection, we will argue that colonial laboratories paid a great deal of attention to diseases that affected the cavalry, such as surra or glanders, while ignoring cattle diseases that caused excessive mortality, such as rinderpest. The reasons behind this will be explored, and links will be drawn with the nature of the incipient Civil Veterinary Departments in India. The paper will also look at the working of Pasteur Institutes that were established in India during this period. The overall aim of the paper will be to examine the attitude of the Indian state towards bacteriological theories, which had gained wide acceptance all over Europe following the discoveries made by Koch, Pasteur and others.

Anna MOHR | ETH Zurich, Switzerland

The production and circulation of medical statistics in the British Empire

This paper analyses medical statistics and numerical methods used in the British Empire in the nineteenth century, ostensibly to equip medicine with a scientific footing and a rational basis for disease prevention and treatment. Medical practitioners serving in colonial armies of the British Empire, especially in India, were among the first to adopt these numerical methods. The paper looks at the practice of compiling medical statistics in colonial situations and analyse them with respect to the negotiation of racial, social and gender differences.

S005. Mathematics and machines: explorations of machine-assisted mathematics since 1800

Fri 26 July, 09:10–17:40 • Roscoe 2.3

Symposium organisers:

Maarten BULLYNCK | Université Paris 8, France

Liesbeth DE MOL | Ghent University, Belgium

Marie-José DURAND-RICHARD | Laboratoire SPHERE-UMR 7219, France

Symposium abstract

The classic image that comes to mind when thinking of the ‘mathematician at work’ is that of a man sitting alone at his desk, working with his pencil on a piece of paper. Modern historiography has taught us that this image is incomplete: mathematics and its history are more than just proofs. The mathematician is part of a social, economic and political context, he takes part in the communication with his colleagues through conversation, writing, print and teaching, s/he is as a human being also subject to historical, biographical and psychological fluctuations. Importantly, there is also a technological side to the mathematician’s

work. Going beyond the mere pen-and-paper, the mathematician has always used instruments to assist him/her at work, instruments that help shape the mathematics (and vice versa). Recently, this impact has grown due to the multiple usages of the digital computer within mathematics. Mathematicians like P. Borwein thus claim that “*computers [are] changing the way we do mathematics*”. Indeed, computing machinery has changed how mathematical knowledge is obtained and (trans)formed. A historical and critical reflection on this discursive shift is necessary to put this (r)evolution in perspective. This symposium wants to be involved in this reflection by looking into the history of mathematician-machine interactions, embedding the current situation of computer-assisted mathematics into its proper context and historical evolution where the modern computer does not figure as a discrete transition point but rather as a part of a continuous and steady evolution that started in the industrial age and continues up to now.

S005-A. Approaching machines and mathematics

Fri 26 July, 09:10–10:40 • Roscoe 2.3

Chair: Maarten BULLYNCK | Université Paris 8, France

Discussion

Including introductory comments from the symposium organisers.

Peggy Aldrich KIDWELL | Smithsonian Institution, United States

Mathematical recreations and machines

Machines have profoundly influenced the content, distribution, and presentation of mathematical recreations from at least the nineteenth century. At that time, changes in manufacturing processes, combined with improvements in transportation, made it possible for merchants to stock and sell a wide range of consumer goods, including games and toys. Increases in the income of many people, combined with greater leisure and the rise of separate goods for children fostered this movement. Wider availability of newspapers and advertising encouraged the diffusion of recreations across national and international lines.

By the early twentieth century, mechanisms were embedded in recreational instruments for drawing curves. A toy called the Wondergraph, invented in the United States and patented in Europe as well, automated this process and made it easier to replicate results. The adaptation of mathematical drawing instruments for recreational use would continue for much of the century, intriguing both the general public and a handful of mathematicians.

Attempts to create game-playing automata date to the eighteenth century. With the advent of the electronic computer, these efforts took on renewed vigor. Computers were programmed to recommend moves in traditional games including tick tack toe, checkers and particularly chess. By the end of the century, such games were embedded in carnival attractions, in software for home users, and in special purpose computers such as IBM’s Deep Blue. Computing devices also generated entertainments, ranging from simple arithmetic problems for young children (as in the Little Professor and the Flashmaster) to logical puzzles for adults (as in Sudoku).

The interplay between mathematical recreations and machines depended on changes in both mathematics and machines. Exploring this story reveals interconnections between historical ideas, technological novelties, and mathematical communities. As an entryway to this international story, it is useful to focus on changes in one country, the United States. Existing historical accounts, museum collections, and trade literature all offer important insights.

Johannes LENHARD | University of Bielefeld, Germany

Mathematics, machines, design: Carl Runge and the contested status of numerical mathematics

Carl Runge (1856-1927) was among the foremost applied mathematicians of his time. He pioneered numerical methods and he put them into a framework of building mathematical models. Runge's work received controversial interpretations regarding the status of numerics and applied mathematics. In the present paper, I want to argue that this controversy is connected to an increasing tension between engineering and mathematics. In the very late 19th century mathematization of engineering gradually advanced while at the same time education and research in "pure" university mathematics followed a different trajectory. This led to an increasing gap and to the formation of two different camps regarding the role and position of applied mathematics. The one claimed applied mathematics would bridge the mentioned gap and foster an hierarchically ordered architecture with a flow from pure or theoretical to applied mathematics. The other camp favored an applied mathematics that would help to create an autonomously mathematized engineering science. Based on an analysis of Runge's work, it will be argued that his position combined traits of both camps.

Three points highlight Runge's position. First, he designed a general methodology of numerical modeling and analysis rooted in pure mathematics. Although aiming for a general viewpoint, he also took into account the problems raised by abstraction and idealization and he insisted that the construction of numerical models had to respect an array of conditions. Namely, and this is the second point, his conception of mathematical modeling respected available instrumentation and concrete design tasks - any model had to be practically executable for a given purpose with a given instrumentation. Thirdly, he saw precise predictions as the main virtue of mathematical models.

S005-B. Numerical mathematics and analog computing

Fri 26 July, 11:10–12:40 ▪ Roscoe 2.3

Chair: Marie-José DURAND-RICHARD | Laboratoire SPHERE-UMR 7219, France

Helena DURNOVA | Masaryk University, Brno, Czech Republic

Václav Láška (1862-1943) and Václav Hruška (1888-1954): machines and practices in calculation in interwar Czechoslovakia

When the Laboratory for Mathematical Machines was established in Prague in 1952, one of its key proponents, next to the chief designer Antonín Svoboda (1907-1980), was professor of applied mathematics in Prague, Václav Hruška. Pioneers in computing machinery in Czechoslovakia expressed their thankfulness for his moral support by naming the lecture room Hruška's aula. Václav Hruška (1888-1954) worked in numerical mathematics (or rather practical mathematics, as it was then called in Czech), initially with his senior colleague Václav Láška (1862-1943). Václav Láška studied mathematics and physics, but his work mainly concerns using mathematics in calculations in astronomy, geodesy, and seismology. Together, Láška and Hruška published *Počet grafický a graficko-mechanický* (Graphical and mechanical calculus) in 1923 and *Theorie a praxe numerického počítání* (Theory and Practice of Numerical Calculations) in 1934, two key monographs on the topic in Czech. Hruška also had a collection of machines used for calculations. As Hruška explained in a reworked version of *Počet grafický a graficko-mechanický* (Graphical and mechanical calculus), published in 1952, the graphical methods were exploited and now the only significant improvement can be hoped for through the use of machines. In my talk, I will explore the various practices in calculation as proposed by Láška and Hruška.

Ulf HASHAGEN | Deutsches Museum, Germany

Analog computing as a failed modernization program in the military-industrial-academic complex of the Third Reich

In the late German Kaiserreich the invention and production of mathematical instruments became a particular strength of the German innovation system—this was part of a general development that made the German instrument industry the world leaders during this period of time. However, after WW I the financial crisis of the German state partly hindered the further development of large scale instruments, and as a consequence other national science systems partly overtook the world leading German science system. The case of the epoch-making *Differential Analyzer* built at MIT by the electrical engineer Vannevar Bush in 1931 serves not only to illustrate this argumentation, but it also shows that the ideology of pure science did not allow building a large scale analog computing machine in the environment of a German university. While some differential analysers were built in Britain and in Continental Europe in the 1930s, the German development started only after the outbreak of WW II, when the rationality of the German science system had changed totally to a rationality of applicability of science for military purposes. In 1939/40 two different ambitious differential analyzer projects were launched in connection with the Heereswaffenamt or rather with the V2 rocket project lead by Werner von Braun. The talk shows how the Third Reich used the scientific competence of mathematicians as resources for the developments of weapons in the military system and how, the other way round, mathematicians used the Third Reich to get financial and personnel resources for the building of differential analysers for their own purposes. Furthermore, it will be analysed, why all the differential analyser projects in the Third Reich failed in the end. The paper aims to focus on fundamental aspects of scientific and technological developments in computing in the Third Reich and to analyse the dynamics of its military-industrial-academic complex.

Loïc PETITGIRARD | Conservatoire national des arts et métiers, France

Analog computing and the mathematics of dynamical systems: 'theoretical dynamics' at the Centre de Recherche en Physique, Marseille, France, 1948-1964

The "Theoretical dynamics" group led by Theodore Vogel (1903-78) at the Centre de Recherche en Physique (Marseilles, France), after 1948 has yet drawn only little attention regarding the history of "non linear sciences". Its contributions are but original and interesting raising the question of the interplay between the evolution of mathematics of dynamical systems and analog computing.

Vogel was an electrical engineer who got into research in physics and mathematical-physics after 1947. He produced many studies, theoretical, mathematical and experimental, concerning the dynamics of systems : non linear oscillations, surging of waves, aging of systems... He founded his group by attracting engineers and physicists, turned to mathematical and theoretical research, but maintaining their ability with experiments and practical numerical calculations. He was a promoter of "mathematics for the engineer" in his lab. His "Theoretical dynamics" group grew at its zenith in 1964 dealing constantly with one constraint : due to financial and institutional reasons, no computer, neither analog nor digital were available in the lab until 1964.

Facing international competition with computer-aided groups, Vogel encouraged his colleagues on the way to developing their own analog devices to deal with calculations, fitted to their specific dynamical systems.

Through this case study, we investigate this original program of research at the crossroad of mathematics and analog computing. We explain how this practice articulate the development of mechanical and electronic systems to render solutions of equations, with the mathematics of differential equations and dynamical systems. We emphasize the role of analogies in this practice as a mean to compare dynamical systems of

different nature, and as a mean to conceive specific calculating instruments. These instruments were intended to render phase portraits of dynamical systems necessary to their geometrical and topological analysis. We must stress the importance given to numerical results and graphical rendering of solutions, to image and numbers in their practice. It is all supported by a clearly anti-bourbakist epistemology, advocated by Vogel following his conceptions on mathematics and their relation to experiments.

We conclude with a few words on the development of the department of "Applied mathematics", which can be seen as the heritage of this group, after the retirement of Vogel.

S005-C. Mathematics through the machine's eye: the advent of digital computing

Fri 26 July, 14:10–15:40 • Roscoe 2.3

Chair: Liesbeth DE MOL | Ghent University, Belgium

Marie-José DURAND-RICHARD | Laboratoire SPHERE-UMR 7219, France

Douglas R Hartree (1897-1958): from the differential analyzer to digital computers

Before the Second World War, differential analyzers were the most important machines built for giving numerical solutions for differential equations, both in United States and some European countries. Arithmetical devices were not considered to handle calculations which involve the processes of the Calculus. During this war, Vannevar Bush (1890-1974), who designed and built the first differential analyzer in 1927, planned a huge electronical model, the Rockefeller differential analyzer project, together with his colleague Samuel H Caldwell (1904-1960). Despite enormous investments mobilized for this project, it was made obsolete by the electronic digital computer ENIAC at the end of the war. This mutation from analog to digital computer has already been the subject of numerous studies, especially from philosophical and sociological perspectives. As he was involved in the construction of these two kinds of engines, Douglas R. Hartree (1897-1958) appears as an appropriate case study to examine this mutation from a mathematical perspective. Beyer professor of applied mathematics (1928-37) at Manchester University, Hartree obtained the plans of the differential analyzer from Bush, and made one model built in Manchester in 1935, and another one for Cambridge in 1938. As he was an expert in numerical calculations even before the building of these machines, he rapidly extended their use to a great deal of general problems, far beyond the self-consistent field problem for which he initially designed them. And at the end of the war, Hartree was invited to USA, to help managing the ENIAC for computations. Plummer professor at Cambridge University from 1946, Hartree worked on the EDSAC and published a synthetic paper on Calculating engines, where he reviewed analog and digital machines. His Numerical Analysis (1952) reported on their computation methods. So the entire career of Hartree, together with his publications and his practice of both differential analyzers and digital machines, made him a particular relevant example to investigate the continuities and ruptures occurred between the two types of machines, with the following issues for both : - what kind of – differential and partial differential – equations were solved ? - how these equations had to be written in order to be solved ? - how control theory, first initiated from the differential Analyzer, could be mathematically transferred in computer ? - what kind of problems were solved ?

Allan OLLEY | Independent scholar, Canada

A task that exceeded the technology: early applications of the computer to the lunar three-body problem

The Three-Body problem is a famously intractable aspect of Newtonian mechanics. The demand for highly accurate predictions of one instance of the problem, lunar motion, led to practical approximate solutions of great complexity, constituted by trigonometric series with hundreds of terms. Such considerations meant there was demand for high speed machine computation from astronomers during the earliest stages of computer development.

One early innovator in this regard was Wallace J. Eckert, a Columbia University professor of astronomer and IBM researcher. When IBM unveiled its first large electronic machine the Selective Sequence Electronic Calculator (SSEC) in 1948 Eckert chose the starting problem as a more accurate calculation of Lunar positions based on the work of his mentor E. W. Brown. Here the speed of electronic computing was used to make practical arithmetic previously to onerous in time and effort. In the 1950s and 60s Eckert would seek to improve the underlying equations for Lunar motion to achieve new levels of accuracy. This involved two distinct efforts involving two different complex analytic solutions to the problem, both involving solutions proposed in the 19th century, that would make extensive use of computer capabilities of the day.

In my paper I will discuss Eckert's work, his choice of techniques in lunar theory, the role of computers and connect his work with other developments in celestial mechanics and mathematics. Eckert's work was the state of the art in his day and formed the nucleus of the trajectories of the Moon NASA used in their lunar missions. However, NASA's lunar missions also demonstrated the limits of Eckert's techniques and new numerical integrations of the lunar motion would be developed to meet the demands for accuracy of space exploration. Eckert had himself used numerical integration in planetary astronomy but opted for more traditional analytic techniques in his lunar work. Despite its status as applied these developments tested mathematical issues such as the convergence of series solutions and appropriate techniques for solving large systems of linear equations. My research draws on the published record, Eckert's papers and interviews with some of the participants.

Maarten BULLYNCK | Université Paris 8, France

Computing primes with the help of machinery (1929-1949)

Looking at how a list of primes is computed with the help of digital computing machinery during the years 1929 to 1949 gives an interesting insight into the complex interrelations between the mathematics of the problem, the peculiarities of the machine and the logical planning of the computation. It also allows for close-reading through this specific example some aspects of the crucial birth period of the modern digital computers, aspects related both to the hardware and the "software". The idea to use machinery for computing primes originated with the mathematician D.H. Lehmer who devised several special purpose machines. The idea is later taken up by C. E. Shannon as an example in his master's thesis on circuitry. Finally, the prime computations reappear, alongside list of squares and cubes, as exemplary computations on the ENIAC and on the EDSAC. The historical sequence of computing prime numbers is marked by a turn from dedicated hardware to writing and debugging software.

Mark PRIESTLEY | University College London, United Kingdom

From computing plan to computer program: Monte Carlo and the 'miracle of the ENIAC'

In March 1947, John von Neumann developed a "tentative computing sheet" for the application of the Monte Carlo method to a problem of neutron diffusion, describing the plan as "well suited to serve as a basis" for either a manual calculation or one performed on the ENIAC. Within a year, however, the ENIAC had been converted from its original programming regime to run in "stored program mode" and von

Neumann's initial plan had evolved into a complex program of around 800 instructions which first ran in April 1948.

A rich collection of archival material, including a number of flow diagrams and the source code for the second version of the program which ran in the autumn of 1948, allows us to trace this development in great detail. This material provides a unique insight into the transformations in computational practice that accompanied the introduction of the automatic digital computer and the effects of these transformations on the conceptualization of mechanical calculation. This presentation will give an overview of the evolution of the Monte Carlo programs, highlighting a number of aspects including:

- the practicality of the Monte Carlo method itself;
- the increasing scope of automation, encompassing organizational as well as mathematical aspects of the problem;
- the growing complexity of algorithmic thinking and the increasingly idiomatic use of patterns such as loops and subroutines;
- negotiation between table look-up and the ad hoc calculation of numerical data;
- the generation and use of pseudo-random numbers;
- the use of the Goldstine/von Neumann flow diagram method in practice.

Historical discussion of the stored program computer has tended to emphasize technology and computer architecture. Consideration of these software artefacts allows us to develop a more rounded picture of the computer in use, however, and suggests that the significance of the machines of the late 1940s to mathematics has as much to do with the coding style exemplified by the ENIAC Monte Carlo programs as with innovations in hardware.

S005-D. Programming mathematics on digital computers

Fri 26 July, 16:10–17:40 ▪ Roscoe 2.3

Chair: Liesbeth DE MOL | Ghent University, Belgium

Stephanie DICK | Harvard University, United States

Reformalism: automated theorem proving and the materials of mathematics

Mathematical theorem-proving was among the earliest domains of interest to Artificial Intelligence practitioners in the United States. Their automation of proof, however, involved nontrivial transformations in the character and constitution of mathematical objects and practices. These transformations were characterized in large part by the material specificity of computing technologies themselves and by the Cold War research ethos in which this work was pursued. This talk will explore one early example - the Logic Theory Machine - developed by Allen Newell, Herbert Simon, and John Clifford Shaw during 1955-1957 at the RAND Corporation. It was designed to produce proofs of logical theorems from Alfred North Whitehead and Bertrand Russell's *Principia Mathematica*. The talk follows the migration of logical expressions and inferences from the pages of *Principia* into the digital media of the JOHNNIAC mainframe computer.

Wolfgang BRAND | University of Stuttgart, Germany

Getting in shape, form-finding in architecture: the force-density method as a bridge between mathematics and machine

In the late 1960s, Hans-Jörg Schek, a mathematician, developed the Force Density Method, a mathematical method to design shell structures consisting of various materials such as fabric, cable nets, or concrete. Starting from a curve fitting ansatz he developed a method whereby a global parameter (force density) would control the shape of a self-supporting structure. Linearising the resulting equations, the solutions

could be computed by the computers available in those days. This case study demonstrates how mathematical insights were used to overcome the limitations of the computing technology at hand in the application area of architecture and civil engineering around 1970. Firstly, we provide the context of conducting calculations using curve and surface fitting or the Finite Element Method in architecture and civil engineering. In a second step, the manner is studied in which these algorithms were transformed into software. The structure of the software packages is examined and their further developments will be traced. Finally, it is shown how the new algorithms contributed to the design of the membrane roof of the 1972 Olympic Stadium in Munich.

Edgar DAYLIGHT | Independent Scholar, Belgium

Edsger W. Dijkstra in the 1980s: proving theorems by programming an ideal, non-existing, machine

Edsger W. Dijkstra, one of 20th century's famous computer programmers, posed the following mathematical question in February 1981:

- "Given a specific function, called *lambo*, how do you prove that it is equal to its own inverse?"

Along with several similar ones, this question illustrates Dijkstra's active involvement with mathematical methodology during the 1980s and 1990s.

Dijkstra proved the above result by writing an original computer program that calculates *lambo* and by gradually transforming that into a symmetric program --- a program that is useless to the programmer but of value to the mathematician! In contrast to the practical programs that he had written for real, finite, computing machines during the 1950s, he was now writing non-terminating programs in which variables obtain arbitrarily large values and where function values are calculated ad infinitum.

Dijkstra's proof furthermore demonstrates how he transferred what programming methodology had taught him to mathematical methodology: symmetry, so dear to him in his earlier years as a programmer, also played a crucial role in his mathematical methodology and in his *lambo* example.

Calculational reasoning became Dijkstra's main occupation in the second half of his career. Instead of viewing a program text as an operational description of an abstract machine as he had done during the 1960s, and instead of making analogies to sharpen his intuitive understanding of the problem at hand, Dijkstra began to view a program text as a formula, representing a predicate, in a formal system.

The contradistinction between the younger Dijkstra, the programmer, and the older Dijkstra, the mathematician, is the main theme of my presentation. I will paint a picture of how Dijkstra projected ideas from mathematics onto programming in the 1960s and 1970s, before describing the projection in the other direction --- from programming methodology to mathematical methodology --- and before zooming in on the specific *lambo* example.

Commentary: Renate TOBIES | Friedrich-Schiller-Universität Jena, Germany

S006. Empires of longitude: international perspectives on navigation, mapping and science

Sat 27 July, 09:10–15:40 ▪ Roscoe 1.010

Symposium organisers:

Richard DUNN | Royal Museums Greenwich, United Kingdom
Margaret SCHOTTE (non-participant) | Princeton University, United States

Symposium abstract

Accounts of the quest for accurate methods for determining longitude at sea have predominantly focused on the development of timekeeper and astronomical methods in the eighteenth century in the wake of the British Longitude Act of 1714. English craftsmen and men of science have taken a prominent place in these narratives, yet the problem of position-fixing while on a moving ship had long faced mariners worldwide.

This symposium adopts a wider international perspective and a longer time-frame, looking at practical seafaring tools and techniques already well-established in seafaring nations before 1714 and at the efforts of a range of professional communities to address navigational problems. It will also look at attempts throughout Europe to develop longitude-finding methods over the course of the eighteenth century and into the nineteenth, at times (but not only) in response to the British Act. These were efforts that threw together different communities – including astronomers, mathematicians, seafarers, instrument makers, mapmakers, politicians and others – in the search for solutions to a problem with pragmatic applications to the routine movement of people and property around the world's oceans.

Speakers will examine not only the exchange of technical, navigational and cartographic knowledge within and between European countries but also the encounter between western modes of navigation, in which latitude and longitude were key parameters, and the practices deployed successfully by the communities into whose territories European seafarers encroached in the eighteenth and nineteenth centuries.

S006-A. State interests

Sat 27 July, 09:10–10:40 ▪ Roscoe 1.010

Chair: Rebekah HIGGITT | Royal Museums Greenwich, United Kingdom

Richard DUNN | Royal Museums Greenwich, United Kingdom

Clocks and courts: Anglo-Dutch-French relations in seventeenth-century attempts to perfect the marine timekeeper

Finding longitude at sea was a problem well before 1714, firmly established as a subject of scholarly discussion and debate among European philosophers by the 17th century. It was also a matter of practical interest to seamen and to political leaders of the major seafaring nations.

By the 1660s, active attempts were being made to develop marine timekeepers in England, the Netherlands, France and elsewhere. By looking at some of the surviving evidence of this work, including some of the timekeepers tested at sea at this time, this paper will explore the relationships between individuals, academic societies and states in the attempts to develop working machines for finding longitude.

Wolfgang KÖBERER | Independent scholar, Germany

German work on the longitude problem

In contrast to other European countries there was no 'longitude prize' in Germany. This is largely because no centralized German state existed until the late nineteenth century and shipping out of German ports mostly took place in Northern waters – from the North Sea and the Baltic and travelling no further than the Iberian peninsula and the Mediterranean.

In spite of this there is a considerable literature dealing with the longitude problem by German authors and in the German language. This talk will

present some of the tracts and booklets produced from the mid-seventeenth to the late-eighteenth centuries and try to set them in the context of the available methods for finding the longitude and wider international discussions.

Danielle FAUQUE | Université Paris-Sud 11, France

French work on longitude methods in the mid-eighteenth century

Most historiography on the determination of longitude at sea gives a primary role to the British Board of Longitude. Yet the study of documents from the second half of the 18th century in French institutions shows that the question took on a distinct national character in France.

Many projects were sent to the Ministry of Marine (i.e. the King), the Academy of Marine, and above all to the Academy of Science during the period after the Seven Years War (1756-1763), this last institution putting the quest of longitude at sea to competition between 1767 and 1773.

The context was favourable after the success of the sea trials of John Harrison's watch (H4). On one hand Lalande (1759) and on the other Maskelyne diffused the use of lunar distances, the latter after he returned from Saint Helena in 1762, in particular through the *Nautical Almanac*. Maskelyne's works promoted the method that Lacaille had first published in 1755.

Four voyages at sea took place between 1767 and 1772, led independently or jointly by the Academy of Science and the Ministry of Marine. Pierre Leroy's chronometers were tested on board of the *Aurore* (1767) and the *Enjouée* (1769), with Berthoud's clocks tested on board the *Isis* in the same period (1768-1769).

The King, the Academy of Science, and the Academy of Marine jointly set up a fourth voyage. On the *Flore*, both Berthoud's and Leroy's watches were tested in the same conditions and places. Furthermore, octants and sextants revealed their qualities as the best instruments adapted to the lunar-distance method. They were also used to check the working of the marine clocks. This expedition would mark an important step in the life of Jean-Charles de Borda, one of the three commissioners appointed to it. Leroy won prizes in 1769 and 1773, Berthoud not being eligible.

With the testing on the *Flore* and Academy's prizes, the quest of longitude at sea was effectively closed in France. The four expeditions were representative of the period, and each of them showed progress regarding methods of control. From the amateurism exhibited on the *Aurore* ('marine en dentelles', scattered observations, sometimes isolated, no possible comparison) to the rigorous method practised with a team spirit on the *Flore* (groups of savants, results gathered and compared, averages and calculation of errors), we can see that elements of scientific expeditions and a learned marine was coming into place in France at the end of the 18th century.

Jacob ORRJE | Uppsala University, Sweden

State interest and transnational circulation: following a Swedish astronomer into the spaces of English longitude research, 1759-60

In this paper I follow the Swedish astronomer Bengt Ferner around the spaces of longitude research in mid 18th-century London. While Ferner is not a central historical actor in a conventional sense, his extensive travel journal from 1759-60 provides an important insight into the intersections between London's scientific and maritime worlds. There, one can read of Ferner's daily interactions with many key figures, such as John Harrison, Nevil Maskelyne and Christopher Irwin, as well as descriptions of English industrial and naval installations. It also shows the social practices governing entry into the spaces of longitude research in London, as well as the work of circulating useful knowledge in early modern Europe. As a stranger and foreigner, Ferner needed to learn how to navigate the urban spaces of the English capital, as well as

how to interact with the scientific networks of the city. Thus, for the Swedish astronomer, participating in London's science required constant effort and recalibration.

English and Swedish efforts to develop methods for finding longitude at sea were linked to state interests, but were simultaneously researched by scientific communities with strong transnational ties. From Fermer's journal, we can study first how these two seemingly contradictory aspects were part of European science, and secondly what tactics Fermer used to capitalise on these two features of longitude research. Fermer himself was a professor at the naval academy of Karlskrona in eastern Sweden and thus—like many astronomers of the time—his work was aligned with state and naval interests. The objective of Fermer's visit was to establish transnational scientific contacts, as well as to communicate findings of useful English science and industry back to an interested Swedish audience. By following Fermer around we get a glimpse of how state and navy interests on the one hand and transnational circulation of knowledge on the other drove this important 18th-century field of research.

S006-B. Knowledge in circulation

Sat 27 July, 11:10–12:40 • Roscoe 1.010

Chair: Sophie WARING | University of Cambridge, United Kingdom

Alexi BAKER | University of Cambridge, United Kingdom

Friends from foreign parts: international correspondents and collaborators of the British Board of Longitude

International actors represented a significant proportion of the collaborators and especially the correspondents of the British Board of Longitude - which encouraged navigation, technology and 'science' in general in addition to overseeing the large longitude rewards established by Parliament in 1714. These actors encompassed important collaborators such as the astronomers Tobias Mayer and Jérôme Lalande but also a host of correspondents who received varying degrees of encouragement.

The French were naturally best represented given the close, albeit often adversarial, relationship between the two nations and given the complementary work of Frenchmen including Lalande and of institutions including the Paris Observatory. However, correspondents also wrote from an array of other locations across Europe, Russia, and current and former colonies. The rewards and funding on offer, as well as the prestige of gaining the approval of the Board or of Commissioners such as Nevil Maskelyne and Joseph Banks, exerted a powerful lure on a wide variety of individuals.

Although a number of international wars were waged during the 114 years of the existence of the Board, international discord and competition seem to have had a limited effect beyond slowing communications. This was true despite actual attempts at international espionage, as when the French sent the clockmaker Ferdinand Berthoud to try to obtain the secrets of John Harrison's timekeeper. However, the Board of Longitude and its associates seldom expressed concern about such threats, an exception being when the Commissioners briefly quizzed the chronometer maker Thomas Mudge about having discussed Harrison's design with Berthoud in 1767.

By and large, the Board belonged to a network of international actors and correspondents who addressed the longitude and other issues in navigation, technology and 'science' in a surprisingly open manner. This openness was in part down to the importance these issues were often thought to have for 'all mankind', often in terms of trade, and to there being somewhat different approaches to viewing and communicating theories and data than there were to sharing concrete technologies such as chronometers. It was not until the late eighteenth and nineteenth centuries that the French, Spanish and other nationalities began to shift

further away from close collaboration with the British in order to try to become more competitive in these areas of activity and manufacture.

Suzanne DÉBARBAT | Syrte - Observatoire de Paris, France

Nicolas-Louis Lacaille/La Caille and southern-skies astronomy in the service of navigation

Nicolas-Louis La Caille (born 15 March 1713), also known as Lacaille, came to the Observatoire de Paris in 1736/7, when the observatory was under the leadership of Jacques Cassini (1677-1756), son of Jean-Dominique (1625-1712).

Longitudes can be accurately determined on Earth by using the timings of the eclipses of Galilean satellites of Jupiter, as previously shown on the west coast of France and discussed in works on clocks by Huygens (1629-1695) in the Low Countries (1655) and tables compiled by Jean-Dominique Cassini (1668).

Following the foundation of the Royal Observatory in Greenwich in 1675, 'in order to the finding out of longitude of places for perfecting navigation and astronomy', John Flamsteed (1646-1719), the first Astronomer Royal, began to work under the King's authority in the Octagon Room of the Observatory, employing Tompion's clocks, in view of the determination of the longitudes at sea in employing the method of the lunar distances.

In the mid-1730s, two expeditions under the command of the Académie Royale des Sciences left France to reach as close as possible to the equator (in Peru) and the north pole. The 1735 Peru expedition was equipped with a *petit cadran anglais* (a new Hadley's quadrant or octant). The Lapland expedition (1736-1737) was followed by Lacaille's new measurements of the Méridienne de France (1739/1740) after an expedition (1738) along the west coast of France to accurately determine both longitude and latitude.

Following Edmond Halley, (1658-1749), who twice travelled in the southern hemisphere, Lacaille headed for South Africa; while aboard, he tested the lunar distance method. During his voyage, Lacaille determined the positions of about 10,000 stars, leading him being called 'Father of the Southern Skies', and also determined the longitudes and latitudes of every place he visited, including islands, for the benefit of navigators: Bourbon, de France, Ascension, nowadays La Réunion, Mauritius. He also contributed to the determination of the Earth-Moon distance, in cooperation with Lalande (1732-1807), observing from Berlin.

Lacaille's *Cœlum Australe Stelliferum* was published the year after his death (21 March 1762). Having reduced only a small part of his observations of stars before his death, aged 49, the British Association for the Advancement of Science decided to reduce and publish the catalogue of his 9766 stars in 1847. With his large sextant, having a power larger than Halley's instrument, Lacaille could view a much greater number of stars, leading to an anglo-french cooperation with his catalogue in the service of navigation in the southern hemisphere.

Andreas CHRISTOPH | Friedrich Schiller University Jena, Germany

The publishing houses of Friedrich Justin Bertuch: geographical and cartographical knowledge from Weimar, 1791-1907

Scientific exploration of the world during the long 18th century was a determining factor which influenced the academic establishments of geography and cartography. In the context of the professionalization of geodesy, topography, and ethnology, a critical gaze was focused on the validity of measurements, mapping, and of textual descriptions. New standards for maps, atlases, and globes – but also itineraries and school books – were launched at that time.

The aim of this paper is to foster discussion of different popularization-strategies of specialized geographical and cartographical knowledge by the publishing houses of Friedrich Justin Bertuch and his successors. In

1791, Bertuch began to operate under the name of “Landes-Industrie-Comptoir”. Since 1804 he specialized in the distribution of maps, atlases, and globes, through the separate “Geographisches Institut”.

By spotlighting archival material from the Bertuch archives it is possible to emphasize the convergence of spatial knowledge in geographical and cartographical products between 1791 and 1907. This demonstrates how cartographically-fixed landscapes became included within trading networks.

At the 24th International Congress of History of Science, Technology and Medicine I will recount the intentions and technical implementations of the production and distribution of geographical knowledge in its transition from manufacturing to serial production.

Georgina RANNARD | University of Edinburgh, United Kingdom

Maps, mariners and the Magellan Straits: English map-making in an Atlantic context, 1660-1714

Discussions of early modern English maps and sea charts have tended to focus on ahistorical questions of accuracy and progress in mapping. This emphasis on the assessment of the ‘quality’ of information contained in maps has often obscured the diverse range of people, activities and locations involved in the creation of these objects. In particular, the increase in Atlantic voyages for discovery and trade in the seventeenth and eighteenth centuries provided opportunities for the collection of information for maps. This paper aims to begin to re-insert maps and charts into this Atlantic context, and will consider the role of ‘New World’ sources of information in a series of maps and charts of the Atlantic published in London 1660-1714. Looking predominantly at English-made maps as well as sea captain’s journals and mariner’s observations, this paper will also question the traditional condemnation of some English map-makers as ‘plagiarists’. Instead it will suggest that the practice of exchange or use of information from international sources was a fundamental aspect of map and chart production in the late seventeenth century. Firstly it will discuss map-maker William Hack’s manuscript atlas of the South Seas produced from Spanish sources in 1685, and secondly, Sir John Narborough’s voyage to the South Seas in 1669, his hand-drawn maps, and map-maker William Thornton’s chart of the Magellan Straits in 1673. These stories will contribute to discussions of how some forms of natural knowledge were created at significant geographical distance from what have been seen as traditional centres of ‘science’.

S006-C. Navigation, encounter and exchange

Sat 27 July, 14:10–15:40 ▪ Roscoe 1.010

Chair: Richard DUNN | Royal Museums Greenwich, United Kingdom

Katy BARRETT | University of Cambridge and Royal Museums Greenwich, United Kingdom

‘À cause de la Longitude’: in search of international longitudinarians

Thanks to Dava Sobel’s *Longitude*, the story of the British search for the longitude has been focused around the conflict between John Harrison the clockmaker and the lunar distance method espoused by Nevil Maskelyne. What little literature has discussed other actors and proposals in this process has, likewise, focused on the British context and British interactions.

Yet, on reading the many pamphlets which were instigated by the 1714 British Longitude Act, it becomes clear what a variety of schemes were proposed, and how aware ‘longitudinarians’ were of each other’s disparate ideas. Pamphleteers actively considered and criticised other proposals, either ridiculing or building on the ideas therein, and

questioning the motives behind their contribution. This took place not only within the London community, but countrywide, across the channel, and across Europe. ‘Longitudinarians’ were aware that many countries sought a solution and offered prizes, and that many people were seeking to win them.

This talk considers these interactions from two angles. Firstly, it considers the proposals that came from abroad and were discussed by other contributors, how these interacted with the British context, and what they added. Secondly, it considers the process of information dissemination that made the British longitude prize internationally famous and, more crucially, of mis-information: what got distorted in transit, and therefore how the British longitude prize was seen by its international contributors.

Héloïse FINCH-BOYER | Royal Museums Greenwich, United Kingdom

‘A better account of the stars’? Navigational encounters between Europeans and Polynesians in the eighteenth-century Pacific

Scholars working on the Pacific have long sought to understand the indigenous techniques of star-based navigation and wayfinding first described by Captain Cook and Joseph Banks in their voyage with Tupaia, a religious leader, from Tahiti to New Zealand. Recent work has shed light both on the charts authored by Tupaia, and the systems of navigation and wayfinding used by Pacific peoples to accurately navigate out of sight of land. By comparing how contemporary anthropologists seek to understand Polynesian navigation techniques with 18th century accounts of Tupaia’s wayfinding skills, this paper demonstrates the productive encounters between European and Polynesian methods of ordering space.

Michael BRAVO | University of Cambridge, United Kingdom

Encounters and near misses: bridging instruments and ethnography in the theatres of Oceanic empires

The comparative study of different cultural traditions of navigation and encounter is both fascinating and frustrating. Bridging the techniques of navigation between European and indigenous societies was a much celebrated feature of Enlightenment voyages of discovery, particularly in oceanic theatres of empire. While navigators and their readers have been captivated by stories of cartographic exchanges on islands and ice floes, historians of science have never quite been persuaded that these episodes bridge the great divide between seemingly rival sources of authority: practices of precision measurement inscribed in the divided circle, and narrative practices of description emerging out of ethnographic observation and exchange. Rather than seeing these as being incommensurable, it is proposed instead that each way of knowing presents a different aspect of a more general set of problems about the nature of science and empire: namely, the relationships between orientation, autonomy and reciprocity.

Commentary: Richard KREMER | Dartmouth College, United States

S007. Dynamics of knowledge: how technologies evolve, triumph and die

Sponsoring body:

Newcomen: the International Society for the History of Engineering and Technology

Fri 26 July, 09:10–12:40 ▪ Uni Place 4.205

Symposium organisers:**Jonathan AYLEN** | University of Manchester, United Kingdom**Julia ELTON** | Newcomen Society, United Kingdom**Arjan VAN ROOIJ** | Radboud University Nijmegen, Netherlands**Symposium abstract**

Technologies are often modified almost as soon as they are implemented as knowledge accumulates through informal learning and formal R&D. Operating experience, pressure from users, follow-up inventions and competition from rivals all induce changes and developments in novel technologies. After all, fuel efficiency of the stationary steam engine improved 20 fold in 170 years. These sessions examine the creative and competitive forces that improve technologies and often result in their destruction and replacement. Papers consider the way in which knowledge grows, spreads and then becomes obsolete.

Improvements in know-how may be the gradual accumulation of incremental changes as a technology develops along a dominant trajectory. Sometimes technical changes are radical and display unforeseen shifts in direction, often prompted by outside forces and newcomers to an industry. These changes may upset just one part of the supply chain – valves to transistors to integrated circuits, for instance – and leave users unaware. Other changes may bring complete shifts in know-how – steam to electric or analogue to digital, for example. These dramatic changes often force the emergence of new disciplines and new sets of craft skills.

These sessions assemble papers that look at broad themes such as the way in which knowledge based economies transform themselves over time. It will also focus on the detail of these transformations – the way in which technologies are modified in practice with experience and R&D and look at how these improvements get selected for use. How do engineers know what they know? How does learning take place? How far are manufacturing skills tacit and learned on the job, and how far are they the result of formal training?

The reality of these stories is of particular interest – the setbacks, false starts and blind alleys that characterise the reality of engineering development. In this context, we include papers on “rejected” technologies that have failed or lost their niche in the restless market place for know how. There is also a keen interest in the forces that generate these transformations – entrepreneurs, innovative engineers, the pressures of war, government policy and – above all – the relentless selection mechanism of the competitive process in market economies. Bringing the story up to date, what are the lessons for training and education if technologies are so restless?

S007-A. What is progress?

Fri 26 July, 09:10–10:40 • Uni Place 4.205

Chair: David PERRETT | Queen Mary University of London, United Kingdom**Stan METCALFE** | University of Manchester, United Kingdom**Restless capitalism**

“Why do capitalist economies evolve in the way that they do?” The answer lies, on the one hand, in the nature of human curiosity and the corresponding growth of knowledge. On the other hand, the rules of the game induce the self transformation of each particular economic order. The history of technology shows the manner of self transforming is contingent on the manner of self-ordering – different instituting frames have different dynamic consequences.

Capitalist economies are also *ignorance* economies, in which highly specialised individuals and teams know a great deal about very little, so that the productive strength of the system, its collective knowing,

depends on how the pools of specialised, narrow understandings are connected. Connectivity requires organisation and organisation depends on rules of the game and on belief and trust so that we can rely upon the testimony and actions of others. Economic configurations demonstrate immense richness and subtlety but order is not equilibrium. Systems in equilibrium do not evolve. The day to day structures of capitalism is the product of ordering processes and these structures are restless – their development is open-ended and unpredictable.

Brian PRICE | Newcomen Society, United Kingdom**The role of failure in engineering practice: 1850 to the present**

The paper looks at the place of trial and error as a formal part of engineering practice, how unexpected catastrophe influences engineering standards and behaviours, as well as the more recent influence of litigation and product liability on tolerance for failure. I am particularly interested in how failures are reported through engineering institute lectures and publications – in the past, reporting of failure was encouraged and added considerably to the engineering body of knowledge, whereas nowadays reporting of failure, even in a prototype or lab environment, is strongly discouraged by the corporate lawyers. My thesis would be that this limits the body of engineering knowledge.

Jonathan AYLEN | University of Manchester, United Kingdom**Stretch: how innovation takes place once plants are built**

Manufacturing industries are characterised by large fixed items of capital equipment. Transport and many public services have substantial infrastructure. This paper asks how innovation takes place once new plants have been built and investment in civils has taken place. Stretch is the mechanism by which established items of capital equipment incorporates improvements in process and product technology and make higher output and new products as a result.

A taxonomy of “stretch” is proposed looking at five inter-related features: improved intensity of hardware use through experience and better maintenance; system wide effects of improvements in feedstock and downstream processing; “bolt-on goodies” and physical reconstruction of existing plants; and quality enhancement and new products. Intensity of use encompasses familiar learning effects, but also enhanced maintenance. The concept has wide application across process industries, manufacturing, transport and services. From a theoretical point of view stretch is the expression of evolutionary problem solving.

Arjan VAN ROOIJ | Radboud University Nijmegen, Netherlands**Success, failure and stalling: an exploratory study**

This paper looks to success and failure outside the beaten path. It suggests that some firms, also in dynamic high-tech industries, are neither successful nor failures but stalled: they go through enduring periods of underachievement yet do not die. Considerable research has been done to identify the conditions for success and failure, but, particularly in high-tech industries, almost no research has been devoted to companies that stall. This phenomenon nevertheless raises important questions. What does it imply, if we no longer assume that every business in a high-tech industry is necessarily dynamic? Can these firms still be a source of jobs, growth and the renewal of the economy? Can understanding these stalling firms help us understand the nature of high-tech industries and their historical evolution over time?

S007-B. Constructing technologies

Fri 26 July, 11:10–12:40 • Uni Place 4.205

Chair: Jonathan AYLEN | University of Manchester, United Kingdom

Fred STARR | Newcomen Society, United Kingdom

First strides in high-temperature metallurgy and the internal combustion engine

The exhaust valve in the internal combustion engine was the first engineering component requiring strength and oxidation resistance at temperature. It was critical to the improvement of power units for motor cars and aircraft. The best valve alloy, up to 1915, was a tungsten tool steel, itself a serendipitous development. It had good strength, but poor resistance to oxidation. Fortunately, rust resistant stainless steels, and wear resistant cobalt alloys, containing chromium, were coming into production, and were found to have good oxidation capability. But the first group of alloys with really good oxidation properties were nickel-chromium alloys, specifically developed for resistance wires in bread toasters. These three groups provided the basis for all future developments in exhaust valve metallurgy. By 1930, an engineering science approach to alloy design was emerging, but progress was largely empirical, with a requirement to deeper understanding only emerging with the invention of the jet engine.

Ed MARSHALL | Newcomen Society, United Kingdom

Making the connection: the Ferguson system

Over centuries man has tilled the soil by 'towing' a plough or other implement across a field. Originally the power was supplied by oxen, donkeys or horses. In the 19th century steam was used and this was followed by the internal combustion engine in the form of a tractor. The accent here is on 'towing' which was common to all these systems but, viewed in retrospect, has many disadvantages for tractor haulage.

In the 1920s these disadvantages were recognised and addressed by an Irishman, Harry Ferguson, and following a period of experimentation and evolution he developed a system whereby a variety of implements become part of the tractor by using a simple three point mounting. The use of hydraulics and the simple mechanics of weight transfer completely transformed not just the ploughing process but many other procedures in agriculture. Initially he struggled to have the system accepted but today almost all of the world's tractors utilise the three point Ferguson System which results in more efficient tilling of the soil, greater land use and consequently increased production.

Martin GREGORY | Newcomen Society, United Kingdom

Superseding the seamstress: the sewing machine, from invention to mass production in a generation

The industrialisation of the cloth production into large factories came in the eighteenth century. However, making cloth into clothes remained a hand operation until the mid-nineteenth century. The invention of the sewing machine evolved from significant technical innovation by many workers, producing stitches that could not be made by hand. Alongside innovation in business practices such as the Patent Combination, Hire Purchase and Part Exchange, the sewing machine industry inaugurated major advances in 'interchangeable manufacture'. To produce the millions of cheap machines, each containing many small precision parts, required its own machine tool revolution.

S008. *Science as Public Culture* revisited

Thu 25 July, 09:00–12:30 • Uni Place 3.204

Symposium organisers:

Jim ENDERSBY | University of Sussex, United Kingdom

Karen RADER | Virginia Commonwealth University, United States

Symposium abstract

In his path-breaking work *Science as Public Culture* (1992), Jan Golinski urged historians, philosophers, and sociologists of science to pay more careful attention to the ways in which the boundaries between supposedly elite and popular science were negotiated and defined. Attention to such "demarcationist issues," has been a hallmark of much STS-related scholarship over the last twenty years, but this approach creates an unexamined tension. By defining "science and popular culture" as a field of inquiry in relation to the history of scientific disciplines, historians have been reluctant to assess synthetic or generalist questions – such as the extent to which "'popular science' and its cognates" are historically unified or "variable and multiple." (Pandora, 2009) This symposium will focus on more recent sciences and the myriad ways in which they entered public consciousness in the twentieth century. Speakers will examine the ways in which science provided resources for the public to debate their political and economic concerns and how these in turn shaped the ways in which science was presented and promoted by experts. The symposium aims to offer a re-evaluation of science as public culture, in Anglo-American institutions and media, from the mid nineteenth into the late twentieth century.

S008-A. Institutions

Thu 25 July, 09:00–10:30 • Uni Place 3.204

Chair: Jim ENDERSBY | University of Sussex, United Kingdom

Matthew WHITE | University of Florida, United States

Providing for the rapidly growing want of the people: the Wagner Free Institute of Science of Philadelphia and Urban Reform in the late nineteenth century

This paper will explore the creation and development of a scientific organization dedicated to free science education for the citizens of Philadelphia that was created in a city already rich with scientific institutions and their associated patrons and political constituencies. Of primary interest will be the challenges faced by the Wagner Free Institute of Science of Philadelphia (WFIS) in confronting the intellectual and political elite of a 19th century American city undergoing the changes wrought by the Industrial Revolution and subsequent eras of prosperity and reform. Mercantilist and amateur natural history collector William Wagner founded the WFIS in 1855 for the improvement of the city and its people. He was inspired by the great civic and scientific institutions of the US and Europe such as the Cooper Union in New York City and the Museum d'Histoire Naturelle in Paris. Wagner started lectures in his own home with his own collection, moving to its current building upon its completion in 1865 and continued to teach and run the WFIS until his death in 1885 when the reins were turned over to famed American paleontologist Joseph Leidy who instituted a more ambitious and professional agenda of scientific research and communication. Responding to the dislocation and rapid changes to urban America during the mid-to-late 19th Century, William Wagner, along with a network of local intellectual and economic allies directly and indirectly challenged the growing disconnectedness and elitism of existing Philadelphia scientific institutions and their stakeholders. These challenges not only created a new, democratic space for public science, but also brought William Wagner and his network of scientists and science popularizers in contact and conflict with some of the most renowned and powerful scientists and local politicians of their day, both to the WFIS's benefit and detriment. I will explore the specific goals and motivations of the founder and his network, their strategies for achieving these goals in terms of curriculum, display, and outreach, and assess the success of the institution in reaching their target audiences and effecting the changes they sought while working within the existing political and intellectual power structures of their time. The paper will

conclude with a consideration of how the work of the WFIS was influenced by historic trends both internal and external to the scientific enterprise and how the WFIS in turn influenced the community they served to create unique place for popular science.

Samantha MUKA | University of Pennsylvania, United States

Separate spaces, shared science: the role of public aquariums at early marine laboratories

In 1902, The United States Bureau of Fisheries (USBF) opened a permanent marine laboratory on Pivers Island in Beaufort, North Carolina. The two-story structure, situated on a nearly inaccessible island, contained a public aquarium in addition to laboratory and research space. The new Beaufort station was not the only marine laboratory with a public aquarium attached; The Naples Zoological Station, USBF laboratory in Woods Hole, Massachusetts and the Scripps Oceanographic Institution in La Jolla, California all housed private laboratories and public aquariums in tandem. These spaces were ostensibly dedicated to separate endeavors- scientific investigation and public entertainment respectively. Historians have highlighted the initial inclusion of an aquarium at Naples as economical: the admission to the aquarium space could help fund the marine laboratory (Groeben, 1985). This understanding of the motives and advantages for maintaining a public aquarium at American stations has not been questioned. This paper will challenge the vision of the attachment of public aquariums to marine laboratories as a separate, entirely economically driven endeavor. Utilizing records from the USBF Beaufort and Woods Hole laboratories and the Scripps Oceanographic Institution, and drawing on the work of Mary Sunderland, Karen Rader and Victoria Cain, I will show that these seemingly separate spaces were co-producers of knowledge about marine organisms and their native environments. Closer inspection reveals a complex network of interactions between the public aquarium and marine laboratory spaces. Laboratory and aquarium spaces shared similar technologies, organisms, and workers. The requirement of maintaining captive organisms, for experimentation or display, linked these two spaces and facilitated conversation between private and public science spaces. Analyzing these spaces together sheds light on the interaction between public science and laboratory spaces and prompts new questions about the role of public institutions in the scientific process.

Karen RADER | Virginia Commonwealth University, United States

Museums as democratizing technologies: Cold War science education and the model of the exploratorium, 1968-85

During the late 1950s, physicist Frank Oppenheimer (brother of Robert) had virtually given up on science – he left academe to become a cattle rancher in Colorado after he was pursued by Sen. Joe McCarthy's HUA-Committee and denied tenure at the University of Minnesota. But when his local Pagoda Springs High School came looking for a part-time science teacher, Oppenheimer agreed to return – and in the process, devised a "Library of Experiments" — a collection of nearly one hundred models of classical laboratory experiments which could be used in aiding the teaching of physics to elementary school children. These models became the basis for Oppenheimer's Exploratorium – the first hands-on science museum based on a pedagogical (rather than entertainment) understanding of the value of interactive exhibits. This paper will describe Frank Oppenheimer's vision of museums as democratizing technologies for the teaching of science and citizenship – a vision embraced by National Science Foundation policy makers as the future of K-12 science education -- and argue that his vision shaped contemporary understandings of the cultural value of museums of science and technology, as well of art, music, and history. This historical case study, therefore, enhances our understanding of the Cold War origins of informal science education, as well as the complicated relationship between popular science, culture, and the modern state.

Erika MILAM | Princeton University, United States

Man the hunted: human nature on screen during the Cold War

In the 1960s, depictions of violence on the screen, whether in films or television, fact or fiction, contributed to a public concern in the United States that unexpected, irrational, or political violence could not be attributed solely to other cultures or other times. This paper investigates Cold War science films exploring human nature, at the intersection of entertainment and pedagogy. The films include public television documentaries (like the American Museum of Natural History's co-produced *Time of Man*), a Playboy production of Morris' *The Naked Ape* and films developed for teaching elementary school students about human nature through anthropology and animal behaviour (*Man: A Course of Study*). I argue that visions of humans as rats packed into over-crowded cities were largely supplanted by the notion that given the right circumstances, all humans could be murderous, naked apes—a curious amalgamation that largely followed Robert Ardrey's simplistic depiction of man as a vicious animal, temporarily endowed with the scientific authority of Konrad Lorenz and Desmond Morris. "Man the hunter" became man the hunted. By the mid-1970s, however, academic scientists almost universally dismissed the idea that humans were mere killer apes and the idea all but vanished from public science conversations as well. Even so, scientific theories of human nature spread far beyond polite dinner conversation and became an aspect of public science that scientists used to define their professional identity, either by embracing these images of humanity or by wholeheartedly rejecting them.

S008-B. Media

Thu 25 July, 11:00–12:30 • Uni Place 3.204

Chair: Karen RADER | Virginia Commonwealth University, United States

Jim ENDERSBY | University of Sussex, United Kingdom

Mutant utopias: evening primroses and imagined futures in early-twentieth-century America

At the beginning of the twentieth century, the Dutch botanist Hugo de Vries published an entirely new theory of evolution, the Mutation Theory, which claimed to overcome what were perceived as major problems with conventional Darwinian evolution. Today, historians and biologists alike tend to dismiss mutation theory as little more than an obstacle on the path to the modern evolutionary synthesis, but during the early decades of the century the USA in particular witnessed intense interest in the theory and its significance, among both scientists and laypeople. The theory was widely discussed in print, everywhere from scientific journals to popular newspapers and magazines. This reporting centered on the species of evening primrose (*Oenothera lamarckiana*) that had provided the bulk of the experimental evidence for the theory. The flower and the theory became a focus for a wide range of imaginative hopes, which were often linked by a distinctively American utopianism, a drive to find a rapid, technological solution for social, political and economic problems. Americans' diverse reactions were linked by the plant's imagined possibilities, but the language in which these possibilities were communicated to the public also helped frame the terms in which the biologists came to express their scientific goals. And so, this paper will argue, the evening primrose helped shape both twentieth-century understandings of biology and the ways in which biology would shape the public sphere, by establishing the terms for key political and economic debates.

Katherine PANDORA | University of Oklahoma, United States

The image of the 'intimate scientist' and vernacular re-creations of modern science

As scientific practitioners in the U.S. professionalized in the late 19th through the early 20th centuries, one of the derivative privileges they claimed was the authority to speak in nature's name within public culture. As a practical matter, such communication was largely delegated to intermediaries such as schoolteachers, journalists, and museum workers, who were to serve as a kind of diplomatic corps on behalf of the scientific community to the everyday world. Unexpectedly, diverse configurations of Americans contemporaneously appropriated these intermediary channels to actively re-create the scientific enterprise according to standards, values, and ends that challenged those that professional arbiters had in view. As a case in point, I will sketch out the startling resilience and persistence of a transformative image that proliferated across the changing mediascapes of the 20th century U.S.: that of "the intimate scientist," a representation that worked to undermine the legitimacy of the view from nowhere. The dimension of the "intimate scientist" formulation that I will highlight here is the recurring theme that it is *where* this scientist lives and works that makes this scientist knowledgeable: that place, surprisingly, is "at home." Out of this domestic siting a number of consequences flow: among them the accessibility of the scientist to the public; the legitimacy of experiential reality; and a refusal to render the human invisible in the search for scientific knowledge. Prominent as a cultural trope in mass-market magazines during the Progressive Era in tales about the California horticulturist Luther Burbank, the image was elaborated further for mid-century audiences in more sophisticated literary forms in the collaborative writing of John Steinbeck and marine biologist Ed Ricketts in *Sea of Cortez* (1941), in Steinbeck's fictionalization of Ricketts in *Cannery Row* (1945) and *Sweet Thursday* (1954), and in Rodger and Hammerstein's adaptations of these works in their musical *Pipe dream* (1955). The epistemic shorthand of the intimate scientist framework was reformulated for the televisual age in striking terms in the CBS Reports' documentary *The Silent Spring* of Rachel Carson (1963) and National Geographic's *Miss Goodall and the wild chimpanzees* (1965), demonstrating both its continuing utility and relevance. Using representative examples such as these to identify the intellectual, social, and cultural dynamics that have supported related efforts to re-create science through innovative prototypes advanced through mass-mediated thought-experiments, scholars can begin to better-understand the tensions that have arisen in the American context between professionals and refractory publics in the past and in the present.

Rebecca ONION | Philadelphia Area Center for History of Science, United States

Environmental pessimism, science, and children's media in the American 1970s

If, as this symposium argues, attention to historically specific popular cultures of science can help us deepen and complicate our understanding of the way that science lives within culture, an examination of the way that science circulates in children's popular culture is particularly important. Children function as implicit targets of many projects of "popular science," but across American history, the social and political aims of these projects have not been uniform. This paper will show how children's popular science in the 1970s reflected shifts in social perceptions of both science and childhood. In that decade, American children's media, influenced by the social movements of the previous decade, began to consciously incorporate messages of multiculturalism, feminism, and social justice. The paradigmatic example of this shift is 1972's "Free to Be You and Me," a television show, record, and book created by TV personality Marlo Thomas, which taught lessons about tolerance and equality. In this paper, I will examine the ways that children's media in the 1970s, while incorporating the counterculture's social goals, also reflected its growing negative attitudes towards science and technology. While children's culture in the United States during the twentieth century had historically been a site for efforts at science recruitment and displays of wonderful technologies, during the 1970s, adult unease at nuclear armament and worry about environmental problems such as extinctions, overpopulation, and

pollution had begun to appear in children's literature, magazines, and television. This paper will examine the National Wildlife Federation's magazine *Ranger Rick*; the television show "Big Blue Marble"; and selected iconic works of children's literature, including the work of authors such as Bill Peet, Dr. Seuss, Richard Adams, Robert C. O'Brien, and Jean Craighead George. Many of these works repeated adult fascination with negative consequences of development, technology, and exploration, often making this point by allying child readers with threatened animals or landscapes. In this paper, I will ask how scientists and science took their place within these cultural depictions of environmental challenges, looking for ways that science's perceived association with militarism and short-sighted profit-seeking might be represented to young audiences. I will examine the production and reception histories of these works in an effort to understand the cultural context within which they were produced. And, finally, I will seek out historical responses of child readers and viewers to these potentially terrifying narratives.

General group discussion

S009. Leonardo da Vinci and the history of science

Thu 25 July, 09:00–10:30 ▪ Roscoe 2.2

Symposium organisers:

J. V. FIELD | Birkbeck, University of London, United Kingdom
Matthew LANDRUS | University of Oxford, United Kingdom

Symposium abstract

Leonardo has often had an ambiguous treatment from historians. Historians of art have never dealt with anything that looks to them so 'scientific' and historians of science have never had to deal with diagrams that are so beguilingly beautiful. The difficulties are partly caused by the narrow specialisms of our day. In Leonardo's time the pattern of division into recognised areas of specialised intellectual and practical work were very different. The obvious division is largely social: between university education, in Latin, and practical instruction, in the vernacular, but the borders seem to have been fairly porous (at least in Italy). Unlike university graduates, trained in the arts of the trivium and the quadrivium (the four mathematical ones often called 'sciences'), craftsmen were expected to make direct use of practical knowledge in their workplaces. In the practical world, 'art' also had a specialised meaning for the trades associated with guilds; for instance the wool guild was called the *Arte della Lana*. These changes in the meaning of the terms 'art' and 'science' can make it difficult to use "actors' categories" properly, but whatever terms one uses it is clear that the intellectual map was very different from what it is today and that craftsmen (among them painters and sculptors) regularly brought considerable 'scientific' knowledge to their work.

In recent years some bridges have been built across today's disciplinary divide, and the emergence of a healthier body of literature on Leonardo offers some opportunities to historians of science to integrate him into a viable image of the natural philosophy, mathematics, medicine and technology of his time - and, of course, to assess his possible contributions to what happened next.

Chairs:

Matthew LANDRUS | University of Oxford, United Kingdom
J. V. FIELD | Birkbeck, University of London, United Kingdom
J. V. FIELD | Birkbeck, University of London, United Kingdom

What the craftsmen taught the scholars about natural philosophy

In the fifteenth century, technology (the crafts) was doing better than either natural philosophy or the sciences in producing works that still have something to say to the twenty-first century. We may contrast Brunelleschi's dome for Florence cathedral (still standing) with contemporary theories of the motion of the Sun (which could not correctly predict dates of equinoxes). Craftsmen, whose activities were attracting increasing attention from the learned, had much to teach scholars about the power of approximate, non-rigorous methods and the usefulness of focussed observation.

Martin KEMP | University of Oxford, United Kingdom

Science and the Codex Leicester

The paper will address the state of Leonardo's research on natural science around 1508-12, with particular interest in the Codex Leicester and his studies of water, hydrology, astronomy, cosmology, fossils, geology, and more generally, the "body" of the earth.

Matthew LANDRUS | University of Oxford, United Kingdom

Leonardo and the art of engineering

Traditional academic assessments of preliminary or unconstructed mechanical engineering projects often address the authors' intuitive approaches to this 'paper engineering'. Estimates for machine studies, compared with detailed calculations for practical engineering projects, were often rooted in similar systematic approaches. In both cases, structural intuitions and measured calculations often extended from standard assessments of proportional geometry. Standard systematic methods helped with updates to projects, from their initial stages to advanced stages. As reflections of antique engineering methods, Renaissance engineers valued these geometric standards for their supposed structural and stylistic reliability and permanence. The present discussion will address Leonardo da Vinci's systematic approaches to the art of engineering and the means by which he responded to similar approaches in medieval and classical antiquity. Recognized in his plans for treatises on military and mechanical engineering, this work involved research on Greek and Roman systems of proportional geometry. To address a general question with regard to his engineering drawings: for what purposes were they developed? Evidence of their development with systematic proportional methods provides part of the answer.

Eduardo KICKHÖFEL | Universidade Federal de São Paulo (UNIFESP), Brazil

The place of Leonardo da Vinci in the history of natural philosophy

The Renaissance was a period dominated by the Aristotelian philosophy. Varchi, in the preface of second of his "Two lessons on painting and sculpture", says that science is "nothing more than the knowledge of the universal things, necessary and consequently eternal, obtained by demonstration", and art is "the disposition to make involving a true course of reasoning", following the definitions of Nicomachean Ethics. Toletus, in his "Commentary on Aristotle's Physics", divides the philosophy into speculative, practical and productive, following the beginning of the sixth book of Metaphysics. However, instead of the higher value given to the *vita contemplativa* in the Antiquity still present in the Middle Ages, Renaissance men like Salutati and Manetti gave new values to the *vita activa*, and craftsmen-writers like Alberti, Ghiberti and Martini aimed to elevate the value of their knowledge and their own social status. Different from the unlettered craftsmen, the craftsman imagined by them was a sort of lettered man who could work from the knowledge of principles and was able to speak about them. However, the definitions and the organizations of knowledge of the ancient texts were well established and clear. Leonardo da Vinci tried to surpass them and tried to identify art and science. After his education at Verrocchio's atelier, in Milan Leonardo began to study matters like optics, physics and anatomy. In the case of anatomy, Leonardo took a very distinctive path, separating himself progressively from the craftsmen and the physicians. Without the prejudices of the university professors, he did dissections,

and for him the painter-anatomist had to know "the good draughtsmanship", "the knowledge of perspective", "the methods of geometrical demonstration and the method of calculation of the forces and power of the muscles". Using his art of drawing, his experience of dissection and his knowledge of mechanics, he could recreate the human figure "without seeing the living [and] without error". However, the definitions and the organizations of knowledge did not permit the synthesis Leonardo da Vinci was proposing. He did not have disciples as an anatomist. It is argued here that Leonardo da Vinci's anatomical studies are products of an active view of life, but still facing the limits of the Aristotelian philosophy present in the Renaissance. The natural philosophy, part of the speculative branch of philosophy, could be aided by the arts, but not directly elaborated by them.

S010. The introduction of mathematics in Iberoamerica (part II)

Sponsoring body:

ICHM: International Commission on the History of Mathematics (International Mathematical Union and DHST)

Wed 24 July, 14:10–17:40 ▪ Roscoe 1.010

Symposium organisers:

Alejandro GARCADIÉGO | Universidad Nacional Autónoma de México, México

Clara Helena SÁNCHEZ BOTERO | Universidad Nacional de Colombia, Colombia

Symposium abstract

The goal of this symposium is to invite an international group of scholars to discuss diverse aspects of the introduction of Mathematics in Iberoamerica.

In previous meetings (e.g., Budapest 2009), we discussed the adaptation of mathematical ideas, concepts and methods developed in the Western Hemisphere from the beginnings of the XIX century onwards. In that particular case, we selected two branches of mathematics (Set Theory and Logic), in order to keep a precise intellectual framework and to be able to unfold coherent and vivid discussions as a consequence of alternative historical reconstructions, even from the same area. It is important to keep in mind that —although most of the countries of this region share similar roots and growths and, as a consequence, it is possible to analyze parallel historical reconstructions— they also own their particular idiosyncrasies and independent evolutions.

On this occasion, in order to enrich the diversity of this symposium, participants will have complete freedom to discuss any intellectual conditions that allowed the introduction of mathematical ideas into Iberoamerica, as well as later developments and subsequent influences and consequences. That is to say, the symposium will not be limited to any specific time and/or branch framework; although sessions will be grouped by time or topic. The event will cover studies since the establishment of printing in the New World (ca., 1551), up to the consolidation of professional mathematical communities (ca., 1960s). Possible examples of time tables of the sessions include: the Colony (1520s to 1820s); XIX; and, XX centuries. Possible cases of thematic sessions include: the lack of texts on Euclidean Geometry; the influence of Positivism during the XIX century and its role in the teaching of mathematics; and, the development of research groups in contemporary mathematics; among others.

S010-A. The foundations of mathematics

Wed 24 July, 14:10–15:40 ▪ Roscoe 1.010

Chair: **Alejandro GARCADIENGO** | Universidad Nacional Autónoma de México, México

Fernando ZALAMEA | Universidad Nacional de Colombia, Colombia

A brief history of the Latin-American symposia of mathematical logic, 1970-2012

The actual consolidation of mathematical logic in Latin America comes from a variety of perspectives, not the least the construction of a solid community of researchers. Fifteen SLALM (Simposio Latino Americano de Lógica Matemática), from 1970 till 2012, have been central for a solid glueing of that community. We will present in our talk a brief history of those SLALMs, underscoring both (i) the impetus of some central figures (Chuaqui, Cignoli, Da Costa, Caicedo, Di Prisco, amongst others) and (ii) the construction of a well-connected web of researchers between leading countries (Brazil, Colombia, Chile, Argentina). The result confirms the role of an oscillating pendulum, in the advancements of science, between local, individual, initiatives and global, community, weavings.

Andrea ARREDONDO | Universidad Nacional Autónoma de México, México

The foundations of mathematics in context: the case of Mexico

In nineteenth-century, the studies led by German mathematicians about arithmetic were characterized by the pursuit of rigor, and of a strong support that served as a solid foundation upon which they could build the rest of mathematical knowledge. This project was developed not only because of the uncertain place on which mathematics of that time found themselves due to the emergence of new and unexpected results in geometry and analysis, but also because it was strengthened by the broader academic context, in which transformations in education and the German values of that period were shaping a particular conception of knowledge in which certain views on what and how should be studied were being privileged.

On the other hand, Mexico's concerns about formality in demonstrations and about the search for a solid construction of mathematics emerged in the twentieth-century, in the decade of the forties, under the context of the establishment of the Faculty of Sciences and the professionalization of mathematics in the country. Because of this, the impact of studies such as those of Frege, Dedekind, Cantor, and Hilbert had a rather pedagogical orientation. An example of this, is "What is arithmetic?", a book written by Francisco Zubieta Russi published in 1953. This book was the first to include the mathematical ideas of the above mentioned mathematicians on the principles that support arithmetic. The preface and the exposition of the notions of arithmetic throughout this book, give a clear idea of how mathematics and teaching of mathematics were conceived in this period.

Clara Helena SÁNCHEZ BOTERO | Universidad Nacional de Colombia, Colombia

The introduction of set theory and modern mathematics in Colombia: the Colombian contribution

The creation of a formal program in mathematics at the Colombian National University at the beginnings of the 50's of the last century is due to the Italian mathematician Carlo Federici and the Hungarian mathematician John Horváth. The latter is responsible for the visits of Solomon Lefschetz, John von Neumann, Laurent Schwartz, Jean Dieudonné, Serge Bisclier, among others, in Colombia. The first alumni

of this program were mostly self-taught, but they took the duty to teach modern mathematics the next generations to come. In this work we present their contribution to this enterprise at university and high and primary school. The first publications done by Colombians on this matter appeared in the *Revista de Matemáticas Elementales* (founded in 1952 and initially published by the Colombian National University and University of the Andes). Beginning in 1965 some documents written by Colombian mathematicians were published and used as university textbooks. Their contents are analyzed in our work. On the other hand, modern mathematics was introduced at primary and high-school using textbooks prepared by the Research Institute of Pedagogical National University. Also in this Institute guides for primary and high-school teachers were prepared and used in normal schools whose mission is to form elementary school teachers. Finally, as a byproduct of this effort, a collection named *Colección Matemática Actualizada* was published. This collection is examined in detail.

This presentation is based on work co-authored with Víctor S. Albis González.

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Alejandro GARCADIENGO | Universidad Nacional Autónoma de México, México

Mathemorphosis: a new methodological tool for the understanding of the history of mathematics

Apparently, throughout centuries, the pedagogy and history of mathematics have maintained a symbiotic relationship. For example, almost as soon as Euclid's *Elements* emerged, as a basic mathematical textbook or part of it in Western culture, some editions included, along the permits and dedications, a chronological section. When this relationship became even more explicit, in particular, parallel to the processes of professionalization of both disciplines in the second half of the XX century, it became a common practice to use, apply and or include history into the pedagogy of mathematics. In this occasion, we will discuss a new powerful tool in this direction.

S010-B

Wed 24 July, 16:10–17:40 ▪ Roscoe 1.010

Chair: **Clara Helena SÁNCHEZ BOTERO** | Universidad Nacional de Colombia, Colombia

Jose A. CERVERA | El Colegio de México, México

The introduction of logarithms into Mexico and China: a comparative study

The Mercedarian friar Diego Rodríguez (1596-1668) is considered to have been the mathematician who first introduced the study of logarithms in the New Spain, just twenty years after the development of this technique of calculation by John Napier (1550-1617). We must not forget that logarithms were developed as a method to carry out arithmetic calculations quickly, which was essential for astronomical calculations as well as for other sciences. Why did logarithms arrive in Mexico years before they were used in Spain? Was the isolated genius of Diego Rodríguez which enabled such a result, or there are objective reasons to understand the delay of Spain in the 17th century mathematics? In order to find answers to these questions, I will consider another example for comparison: the introduction of logarithms in China by the Jesuits in the middle of the 17th century, as a way for the spread of Christianity.

Elena AUSEJO | Universidad de Zaragoza, Spain

The consolidation of infinitesimal calculus in Spain, 1767-1814

A limited introduction of calculus in Spain –on a fluxional basis– took place in a few Jesuit and military institution in the second half of the 18th century, until the expulsion of the Jesuits in 1767.

The setting up the colleges and seminars abandoned after the Jesuits' expulsion eventually facilitated the emergence of teachers and institutions that allowed mathematics to thrive during the following period, up to the Independence War against Napoléon (1808-1814).

This paper presents the network of mathematicians who starred in this process (Jorge Juan, Bails, Juan Justo García, Subirás, Varas, Verdejo, Ibarra, Ciscar, Chaix, and Vallejo, among others) in institutions such as the former Jesuit colleges, military academies, technical institutions, and university. The most relevant works, from Benito Bails' *Elements of Mathematics* (10 vols. 1772-83) and *Principles of Mathematics* (3 vols. 1776) to Vallejo's *Elementary Treatise of Mathematics* (5 vols. 1812-1817), are considered.

From these data, conclusions are established as regards foreign influences and main trends in the consolidation of calculus in Spain. The powerful influence of Jorge Juan definitely tipped the scales in favour of continental calculus, partly for pedagogical reasons, but also because differences between fluxional or infinitesimal approaches were not so important for many Spanish authors during this period: by the end of the 18th century, Leibniz's notation was absolutely dominant, but fluxional concepts were still considered more rigorous. Nevertheless, the concept of limit as defined by D'Alembert and developed by Cousin, gradually emerged from Bails and was adopted by Ciscar, who dismissed differentials despite their usefulness, as a result of his deep understanding of the problem of foundations of calculus.

The theory of limits as the basis for the foundations of calculus, which was a clear precedent for the correct approach to the problem, was also adopted in Chaix's *Instituciones de cálculo diferencial* (1801), the first Spanish work entirely devoted to differential calculus. In this work, functions were the central element of calculus, derivatives –not differentials– were the characteristic element, the expression dy/dx was a symbol –not a quotient– and geometry was relegated to applications in favour of algebra.

Finally, the fourth volume of Vallejo's *Elementary Treatise* (1813), devoted to differential and integral calculus, also followed D'Alembert in defining calculus through the concept of limit, reduced calculus to algebra in Lagrange's style, and introduced Lacroix in Spain, albeit avoiding differentials and including finite differences.

Sergio H. OROZCO-ECHEVERRI | Universidad de Antioquia, Colombia

Political theology and colonial interests in Mutis' defence of Newton's natural philosophy in the Viceroyalty of New Granada

Newtonian natural philosophy first circulated in America –in the first half of the eighteenth century– during the colonial activities associated to the scientific expeditions to Perú and Quito. However, it was not until the Bourbon Reforms in the way supported by the reign of Carlos III, in the second half of the eighteenth century, that the educational system of the Spanish colonies was seriously considered as needing a deep reform for the economic and social improvement of the Empire. Such an educational system of the New Granada was ruled by the Dominican order whose curricula were shaped by the traditional Aristotelian-Scholastic ideas and it permeated the intellectual and social activities of the colony. José Celestino Mutis y Bossio (1732-1808) is well known for his leading role in the Royal Botanical Expedition. He was a Spanish priest that arrived at the Audience of Santafé de Bogotá in 1761 having finished his medical education in Cadiz to become the physician of the new Viceroy Pedro Messía de la Cerda. However, historians have seriously overlooked his defence of the Newtonian natural philosophy,

and his arguments in favour of the usefulness of mathematics for the Viceroyalty, in contrast to the Scholastic thought highly dominant within the social and academic circles of the colony. Mutis' defence of the 'new philosophy' included the first translation into Spanish of Newton's *Philosophiae naturalis principia mathematica* (circa 1770), the creation of the first Chair of Mathematics in the Colegio Mayor de Nuestra Señora del Rosario (1762) along the lines of Newtonian natural philosophy, and the foundation of the first astronomical observatory in America (1802). It is in this context that this paper aims to expose how Mutis' arguments in defence of Newton's natural philosophy were shaped by the colonial interests of the Bourbon reforms and particularly by the political theology there outlined against the traditional and dominant ideas and political structure of the Dominican Order, which even appealed to the Holy Inquisition against Mutis' reformist ideas.

Yolima ÁLVAREZ | Universidad Distrital Francisco José de Caldas, Colombia

From Pombo to Rueda: Determinants in Colombian textbooks of algebra, 1858-1919

In 1858, the engineer Lino de Pombo O'donnell (1797-1862), who was Mathematics teacher at Military College, published the first edition of *Lessons of Arithmetic and Algebra*. In this textbook emerging procedures of the determinants were explained by the author to solve linear system. The form that Pombo explained this topic was similar to Etienne Bézout (1730-1783).

Years later, the Mathematics teacher at the National University, Manuel Antonio Rueda (1858-1907), published many editions of a textbook of algebra, where finally in the ninth edition appeared the determinants. In 1919, the writer and Mathematics teacher, Victor E. Caro (1877-1944) added as an appendix (*Elementary theory of determinants*) to Rueda's book, few pages where explained this topic following other authors.

The aim of this work is to make a general outline of the determinants at Colombian University, from Pombo to Rueda. We will analyze this topic in Colombian textbooks and its relations with the first European textbooks.

S011. Les sciences mathématiques 1750-1850: continuités et ruptures

Tue 23 July, 09:00–12:30 • Uni Place 4.213

Symposium organisers:

Umberto BOTTAZZINI | Università degli Studi di Milano, Italy
Christian GILAIN | Université Pierre-et-Marie-Curie (Paris 6), France

Alexandre GUILBAUD | UPMC, Institut de mathématiques de Jussieu, France

Symposium abstract

Une tradition bien ancrée, en historiographie des mathématiques, présente le passage du XVIIIe au XIXe siècle sur le mode de la rupture radicale et globale. Cependant, sans nier l'existence de changements importants au début du XIXe siècle, il semble nécessaire de parvenir à mieux comprendre la genèse de ces changements et à évaluer, pour chacun, son ampleur et ses limites, en évitant une conception globalisante, supposant a priori la synchronisation de toutes les discontinuités en une rupture générale au même moment.

Ce symposium vise à la fois à présenter une synthèse des résultats obtenus récemment dans ce sens et à ouvrir de nouvelles perspectives. Dans le cadre général de la période 1750-1850, on se concentrera sur

les sujets qui permettent d'alimenter la réflexion sur les rapports entre continuités et ruptures dans l'évolution des diverses sciences mathématiques (mathématiques "pures" ou "mixtes"), de leurs interactions et de leurs dynamiques propres. Les thèmes considérés pourront aussi bien concerner les contenus des savoirs que le statut des divers mathématiciens (académiciens, professeurs, ingénieurs), dans les contextes institutionnels, sociaux, culturels ou politiques des différents pays européens. En se proposant d'étudier dans toute sa complexité conceptuelle et sociale l'évolution des savoirs mathématiques dans une période clé de l'histoire des sciences et des sociétés, le programme de ce symposium s'inscrit dans le thème général du Congrès, "Knowledge at work".

S011-A

Tue 23 July, 09:00–10:30 • Uni Place 4.213

Chair: Christian GILAIN | Université Pierre-et-Marie-Curie (Paris 6), France

Christophe ECKES | Institut de mathématiques de Toulouse, France

Which continuity and which rupture in Lambert's work on perspective?

In this talk, we aim at showing after Kirsti Andersen that Lambert's approach to perspective constructions (first edition of his treatise 1759) is based on an angle scale. This method can be considered as a break with the dominant use of plans and elevations which characterizes the teaching of perspective in several Academies of Arts at that time. In particular, we will compare Lambert's *Freie Perspektive* with Jeurat's *Traité de perspective à l'usage des artistes* (1750) which belongs to a long tradition of teaching perspective at the Académie Royale de Peinture et de Sculpture. Jeurat is deeply influenced by Sébastien le Clerc I (1637-1714) and le Clerc II (1673-1763) who teach geometry and perspective during more than a half-century at the Académie de peinture.

We also would like to assess the impact of Lambert's fifteen geometrical problems (second edition of his treatise, 1774) in the development of ruler geometry during the first third of the 19th century. More precisely, it seems that Chasles and Poncelet believe in a kind of continuity between Lambert's and Servois' contributions on ruler geometry. In fact, this historical interpretation is based on a retrospective projection. More precisely, there isn't any explicit link between Lambert's *Freie Perspektive* and Servois' book entitled *Solutions peu connues de différents problèmes de géométrie* (1805).

Guillaume JOUVE | Université d'Artois, France

Le rôle de l'astronomie et de la mécanique dans l'appréhension des séries dans la seconde moitié du XVIIIe siècle

Au XVIIIe siècle, les séries sont fréquemment utilisées dans des mémoires de mécanique, d'astronomie, de probabilités mais aussi dans la constitution de tables ou dans la résolution d'équations différentielles. Les historiens traitant de cette période ont souvent opposé l'approche "formelle" supposée dominer à la fin du XVIIIe siècle à une approche plus quantitative voyant le jour au début du XIXe siècle. Dans cette description, les interactions fortes entre Analyse et sciences physico-mathématiques au XVIIIe siècle ont souvent été laissées de côté. Nous proposons d'y remédier dans cette communication en examinant notamment les travaux de D'Alembert.

Maria Teresa BORGATO | University of Ferrara, Italy

Before Lagrange: the residual analysis of John Landen

The origins of Lagrange's theory of analytic functions are to be found in Newton's theory of series and fluxions. During his long stay in London in

1766, Lagrange was most likely in touch with the more recent developments of Newtonian calculus. Among these, an important role was played by the residual analysis of John Landen. The method of fluxions is founded on the fundamental principle that every quantity may be supposed to be generated by a continuous increment, in the same way that a line is described by the motion of a point. John Landen (1719-1790) did not believe it to be the most correct approach: since it was a question of algebraic quantities it had to be considered a branch or a development of algebra, which has its own foundations and does not have to resort to those of the science of motion.

Preceded in 1758 by an announcement (*A Discourse concerning the Residual Analysis*), Landen's treatise appeared in 1764: *The Residual Analysis, a New Branch of the Algebraic Art*, in which only finite increments are considered, and the term of "special value" is introduced for the basic definition of the value of the residual ratio when the denominator is null. Then the rules of the residual calculus are constructed and applied to the main problems of analysis: maxima and minima of functions, curvature, quadrature and rectification of curves.

In his introduction to *Théorie des fonctions analytiques*, Lagrange presented the calculus of derived functions as the true foundation of infinitesimal analysis, and described the incongruences and inadequacies of previous attempts to found infinitesimal calculus on infinitesimals of different orders (Leibniz, Bernoulli, L'Hôpital), or on the limit of ratios of finite differences (Euler, d'Alembert). He reproached Newton for introducing motion to his calculus of fluxions, and objected, moreover, to the formulation based on "the ultimate ratios of evanescent quantities" since the quantities were considered when they cease to exist. According to Lagrange, it was to avoid all these defects that a skillful mathematician, ("habile géomètre") John Landen, had proposed a purely analytical method, in which the finite differences of the variables substitute the infinitesimal differences, although Lagrange adds: "on doit convenir que cette manière de rendre le Calcul différentiel plus rigoureux dans ses principes lui fait perdre ses principaux avantages, la simplicité de la méthode et la facilité des opérations".

Luigi PEPE | University of Ferrara, Italy

Continuity and discontinuity in the study of the Euler-Mascheroni constant

The long term problems, such as the study of the Euler-Mascheroni constant Gamma, are a test for the continuity and discontinuity in mathematics: continuity in the subject, discontinuity in the methods. Considering the fact that the transcendence, and, therefore, the irrationality, of e and p was demonstrated in the nineteenth century, the transcendence and the irrationality of Gamma remains the most important open question in this kind of studies. In 1734 Euler discovered that the series of reciprocals of natural numbers differed at the limit of the logarithm for a constant value for which he calculated the first five decimal digits. Unfortunately, the convergence is very slow. Even with 4500 terms the approximation, using the definition, is only good for three decimal digits. Euler carried out most of his scientific activity in Russia and had all his memoirs on this constant published in *Commentarii* of St. Petersburg, where his *Institutiones Calculi Integralis* was also published in 1768-70. This work aroused great interest in Lorenzo Mascheroni, whose *Adnotationes* were then published together with the *Institutiones* in Euler's *Opera Omnia*. Mascheroni took up the calculus in the *Adnotationes* of 1790 in which he started from the results of Euler's differential calculus and integral calculus. He was able to rectify Euler's value for C , reaching the calculus of thirty-two decimal digits, of which only the first nineteen have been revealed to be exact: 0.577215 664901 532860 618112 090082 39. In Munich, 1809, Soldner published his theory on the transcendent function of integral logarithm (*Théorie d'une nouvelle fonction transcendante*) calculating 22 digits for the Euler-Mascheroni constant with a different value from Mascheroni's at the twentieth digit. In 1813 Gauss, in his famous memoir on the hypergeometric series: *Disquisitiones generales circa seriem infinitam* reported the calculus that his pupil, Nicolai, carried out of the Euler-

Mascheroni constant, which was different from the twentieth digit calculated by Mascheroni and in agreement with Soldner's calculation. In 1857 Lindemann, famous for his demonstration of the transcendence of e and p , obtained a value for the constant in a different way calculating with 34 and 24 digits. In 1869 Shanks obtained 59 decimal digits, and in 1871 calculated 110.

Liliane ALFONSI | Université Paris-Sud , France

La guerre de sept ans (1756-1763) et ses conséquences pour les écoles militaires françaises

Le 10 février 1763, la France signe le Traité de Paris qui, mettant fin à la Guerre de Sept ans, abandonne aux Anglais, toutes les possessions françaises d'Asie et de l'Amérique du nord continentale, le Sénégal et toutes les Antilles, sauf Saint-Domingue. Cette guerre se termine par la destruction complète de la flotte française et par une capitulation désastreuse.

Nous verrons comment cette défaite entraînera dans un premier temps la refonte totale des écoles d'officiers de la Marine royale française, la création d'écoles d'ingénieurs de la Marine, et dans un deuxième temps, un tournant important dans toutes les écoles militaires du pays. Ce tournant se traduit par l'exigence d'un niveau mathématique très élevé, voire de pointe, pour les officiers de tous les corps d'armée et préfigure la spécificité de l'enseignement supérieur français, la dichotomie Universités-Grandes écoles.

S011-B

Tue 23 July, 11:00–12:30 • Uni Place 4.213

Chair: Umberto BOTTAZZINI | Università degli Studi di Milano, Italy

Rogério MONTEIRO DE SIQUEIRA | Universidade de São Paulo, Brazil

On French textbooks in the Royal Military Academy and its translators, 1809-1820

The studies of mathematics in Brazil, until the end of the Brazilian First Republic, was mainly developed around engineering schools. The very known and influential center in the nineteenth century, the Royal Military Academy, was founded in 1810 with the arriving of the Royal Portuguese family, which was escaping from the Napoleon's invasion of Portugal. During all the monarchic period, specially in the first half of the nineteenth century, the main use of both mathematical and engineering diplomas was not technical but a social distinction. The French model, introduced by Marquess of Pombal, established an enlightening syllabus which didn't receive huge modifications until 1874, when the military teaching was separated from the civil teaching. In so doing, many textbooks on mathematical sciences, specially translations of French originals, appeared in the first lists of the Imperial Press (Imprensa Régia) in the period to afford the teaching in the Academy with Portuguese textbooks. In my talk, I would like to present some editorial aspects of these books and analyse, in a prosopographical way, the social trajectory of the translators.

Jenny BOUCARD | Université de Nantes, France

Quelques ruptures et continuités autour des résidus et des congruences de 1750 à 1850

La parution des Disquisitiones Arithmeticae de Gauss en 1801 est souvent vue comme participant pleinement à une rupture dans l'histoire de la théorie des nombres. Cette histoire est ensuite souvent centrée, pour le XIXe siècle, sur celle des corps de nombres algébriques et autour de quelques savants allemands et de certains de leurs travaux. On trouve depuis plusieurs années des remises en cause de cette historiographie : cette dernière s'est en effet construite par la recherche de traces d'objets apparus a posteriori et masque ainsi des aspects des

travaux arithmétiques du XIXe siècle. L'objectif est ici de participer à la restitution de ces différents aspects en nous basant sur un corpus de textes publiés entre 1801 et 1850 dans lesquels les congruences ou les résidus sont utilisés, et de discuter le statut de certaines continuités et ruptures évoquées pour les résidus et les congruences et pour la période 1750-1850. Nous nous appuyons sur les résultats obtenus, les méthodes utilisées, les commentaires des différents auteurs, ainsi que sur les sources de la deuxième moitié du XVIIIe siècle auxquelles ils se réfèrent explicitement. L'analyse de ce corpus fait apparaître un ensemble multiforme de pratiques, de réflexions, de résultats en lien avec les résidus et les congruences, ainsi que des filiations et des ruptures mises en avant ou du moins suggérées par les auteurs eux-mêmes. On retrouve finalement des approches variées autour des congruences résultant de combinaisons à différents niveaux de certaines pratiques arithmétiques de la deuxième moitié du XVIIIe siècle. Nous montrerons que l'on ne retrouve en aucun cas une lignée directrice de travaux découlant d'un Gauss ou d'un Lagrange, ou une rupture radicale avec les démarches de ces savants. Pour cela, nous donnerons donc un aperçu de cette ramification complexe de pratiques autour des congruences et nous appuyons également sur des cas particuliers pour tenter d'expliquer leur place ou leur oubli dans l'historiographie traditionnelle.

Christian GERINI | University of Toulon, France, France

Les journaux de mathématiques au service de l'émergence d'une discipline scientifique autonome, 1770-1842.

Les mathématiques ont bénéficié, dans l'Europe du début du XIX^e siècle, d'une nouvelle forme de diffusion qui changea radicalement la communication et les échanges entre les mathématiciens et participa à l'évolution et à la spécialisation de la discipline : les périodiques qui leur ont été spécifiquement dédiés. Le premier journal d'importance édité sur le continent par le mathématicien Français J. D. Gergonne fut un mensuel : les "Annales de mathématiques pures et appliquées" (1810-1832). Des tentatives, souvent éphémères et irrégulières, avaient déjà vu le jour au XVIII^e siècle, mais elles ne permirent pas une pérennité dans les échanges entre mathématiciens et ne touchèrent pas un public « large » (auteurs ou lecteurs) : ainsi par exemple les journaux allemands de C. F. Hindenburg. Nous donnerons un aperçu de ces périodiques dans la première partie de notre exposé : ceux publiés essentiellement hors de France jusqu'en 1794, puis les deux premiers journaux français laissant une place non négligeable aux mathématiques à partir de 1794, à savoir le Journal de l'Ecole polytechnique et la Correspondance sur l'Ecole polytechnique de Hachette. Nous montrerons ensuite comment les "Annales de Gergonne" ont répondu à quatre critères qui en font a posteriori le premier vrai journal de mathématiques : la régularité de parution et la longévité, la présence dans leurs pages de l'ensemble des mathématiques telles qu'on les définissait à l'époque, le fait que ces mathématiques s'y construisaient et progressaient grâce aux échanges entre les correspondants du journal, et enfin le fait que les auteurs des articles finirent par représenter l'ensemble de la communauté mathématique française et étrangère de la période concernée. Pour preuve du changement radical que les Annales provoquèrent dans le paysage éditorial des mathématiques européennes, nous concluons sur les initiatives qu'elles suscitèrent dans l'ensemble de l'Europe, et plus particulièrement : Le "Journal für die reine und angewandte Mathematik", édité à Berlin à partir de 1826 par Léopold Crelle. La "Correspondance mathématique et physique" que Jean-Guillaume Garnier et Adolphe Quételet publièrent en Belgique de 1825 à 1835. Le "Journal de Mathématiques Pures et Appliquées", publié par Joseph Liouville à partir de 1836. Les "Nouvelles Annales, journal des candidats aux écoles Polytechnique et Normale", que lancèrent Orly Terquem et Camille Geronon en 1842.

Thomas MOREL | Université Bordeaux 1, France

Les mathématiques dans les écoles polytechniques à l'intérieur de l'espace germanophone

La création de l'École polytechnique de Paris est habituellement présentée comme le point de départ d'une conception radicalement nouvelle de l'enseignement des mathématiques et de la formation des ingénieurs. On présente ainsi la création d'écoles polytechniques dans l'espace germanophone au XIXe siècle comme l'adoption de ce nouveau modèle parisien.

Pour examiner et amender cette vision, il peut être fécond de considérer l'aire germanophone dans son entier, et non pas comme une juxtaposition d'études de cas. Les études individuelles cherchent à comparer chaque institution technique à la célèbre école parisienne, soulignant autant que possible les points communs. Une approche globale peut être utilisée pour chercher à comprendre les logiques institutionnelles qui existent dans les différents États allemands. Plusieurs institutions de langues allemandes seront comparées, en utilisant les études historiques existantes ainsi qu'une analyse détaillée du *technische Bildungsanstalt* de Dresde (Saxe), et en mettant l'accent sur la nécessité à l'époque d'une ambitieuse réforme d'un enseignement technique souvent obsolète.

De la fondation en Autriche des établissements de Prague et de Vienne, jusqu'à la multiplication des institutions en Allemagne dans les années 1820 et 1830, on peut isoler quelques caractéristiques communes aux écoles polytechniques germanophones. L'approche des mathématiques et le but de leur enseignement divergent considérablement de la France. Par conséquent, si l'École polytechnique de Paris et son succès ont pu jouer un rôle déclencheur, elle semble avoir souvent été une référence prestigieuse plutôt qu'un véritable modèle.

Mathematics in polytechnic schools in the German-speaking area

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Arnaud MAYRARGUE | CNRS, France

Challis, Airy, Stokes et la structure de l'éther lumineux: débats, controverses et épistémologie.

Au début du 19^{ème} siècle, Augustin Fresnel (1788-1827) procéda à un examen du phénomène d'aberration stellaire, découvert par James Bradley (1693-1762) en 1728. Il adopta pour cela le cadre de la théorie ondulatoire de la lumière et fut alors conduit à préciser les propriétés de l'éther lumineux, nécessaire en tant que support à la propagation des ondes. Un examen critique de ces propositions fut entrepris en Grande-Bretagne dans le cadre de l'hydrodynamique. Il contribua à déclencher des controverses entre James Challis (1803-1882), George Biddell Airy (1801-1892) et George Gabriel Stokes (1819-1903). Il s'adossait à la mécanique des fluides telle qu'elle fut exposée dans le *Traité de Mécanique* de Siméon Denis Poisson (1781-1840) auquel il fut souvent fait référence par les protagonistes. Mais pour en comprendre les enjeux, il faut également interroger à la fois les travaux d'Alexis Clairaut (1713-1765) de 1743 exposés dans son ouvrage *Théorie de la figure de la Terre, tirée des lois de l'hydrostatique* et de Leonhard Paul Euler (1707-1783) de 1755 exposés notamment dans son mémoire *Principes généraux du mouvement des fluides*. Un autre auteur auquel les acteurs de ces controverses se référèrent fut Joseph-Louis Lagrange (1736-1813) pour son travail exposé dans la *Mécanique analytique*, en particulier dans le Mémoire sur la théorie du mouvement des fluides inséré dans l'ouvrage et publié en 1781 dans les mémoires de l'académie royale des sciences de Berlin. Ce sont ces échanges, notamment épistolaires, entre James Challis, George Biddell Airy et George Gabriel Stokes que nous voulons examiner ici, afin de comprendre les rôles respectifs qu'ils ont pu jouer dans les propositions nouvelles qui émergèrent alors dans ce domaine.

S012. Arabic foundations of science

Sponsoring body:

DLMPS Commission on Arabic Logic

Thu 25 July, 09:10–12:40 • Roscoe 1.010

Symposium organisers:

Ahmed HASNAOUI | CNRS / Université Paris-Diderot, France
Wilfrid HODGES | British Academy, United Kingdom

Symposium abstract

The symposium will be about the theoretical underpinning that the Arab thinkers themselves gave to their science during and after the period of their greatest successes. The giant figure of Ibn Sina (Avicenna, 11th century) dominates this entire period, and most of our invited speakers have chosen to base their contributions on aspects of Ibn Sina's work.

Two speakers (Dimitri Gutas, K. A. C. Mentrì) will address Ibn Sina's views on empiricism and the logic of scientific discovery. Ibn Sina had a highly articulate view of how we come to new knowledge by reflection on the information that reaches us through our senses. More recent ideas of experiment and abstraction reflect his influence. At the same time Ibn Sina was concerned to describe the logical structure of the sciences.

Two speakers (Riccardo Strobino, Otman El Mernissi) will study aspects of Ibn Sina's view of logic. One central question here is the place of logic within the structure of deductive sciences as a whole. Ibn Sina's views on this, which El Mernissi will set out, are interesting to compare with his later western counterparts such as Bolzano, though lines of influence from him to the later scholars are hard to trace. Another central question is what he understood logical consequence to be; his views on this continued to be discussed in Arabic logic right up to the 18th century, as Strobino will explain.

Other speakers will examine Ibn Sina's contributions in particular areas of science. Hassan Tahiri will discuss Ibn Sina's work in the foundations of arithmetic, and compare it with related work of 19th century mathematicians and philosophers. Methodology was a major concern of Ibn Sina's, and Ahmad Hasnaoui will illustrate this by showing how Ibn Sina reshaped and in part rejected the methods of physics that Aristotle had originally proposed, and how this reshaping rested on an epistemological project. Wilfrid Hodges will show that Ibn Sina taught his students an almost precisely specified proof search algorithm, many centuries earlier than any other similar known algorithms.

Finally Khaled El-Rouayheb will review developments in logic and scientific methodology during the Ottoman period. This period saw a dramatic increase of interest in a science of 'verification', which traces back less to Avicenna and more to early Islamic juridical debates with their concern for evaluating testimonies and opinions.

S012-A. Demonstration and empiricism in Avicenna

Thu 25 July, 09:10–10:40 ▪ Roscoe 1.010

Chair: Wilfrid HODGES | British Academy, United Kingdom

Ahmed HASNAOUI | CNRS / Université Paris-Diderot, France

Avicenna's physics and demonstrative science

While expounding the contents of Aristotle's *Physics*, Avicenna endeavours to follow the model of scientific exposition proposed by Aristotle in his *Posterior Analytics*. Thus he carefully characterises the object of physics, its principles and its domain of investigation. He also dismisses the dialectical method used by Aristotle in the discussion of the principles and refers instead to the metaphysical discipline where these principles are supposed to be demonstrated. Resorting to the *Demonstration* and the *Metaphysics* of the *Shifa'*, I will try to display the epistemological project lying behind the changes introduced by Avicenna in the structure of Aristotle's *Physics*.

K. A. C. MENTRI | University of Exeter, United Kingdom

Avicenna on the logic of scientific discovery: a preliminary statement

Avicenna was the most prolific Arabic philosopher who developed a comprehensive and unified philosophical system with nearly three hundred works attributed to him. Hitherto many studies have been carried out by scholars on his works, but there are even more works which deserve much attention than has been granted until now. To this last point we can take, as a matter of priority, his *Kitab al-Burhan* (Book of Demonstration) of his *al-Shifa'* (The Cure). This paper therefore takes an introductory task to an ongoing research project which explores the epistemological aspect of the *Burhan*. It shall provide an outline of the research plans, a brief analysis of the current studies on the *Burhan*—in terms of its logical and scientific aspects—and followed by a discussion of its epistemological aspect that being principally concerned with.

Hassan TAHIRI | University of Lisbon, Portugal

The role of Ibn Sīnā's intentionality in the construction of numbers

In his monumental work *al-Shifa'* (or the Cure), Ibn Sina (980-1037) has conducted a deep investigation into the concept of number whose status was left in disarray since the discovery of the irrationals. Unlike the Greek tradition which unanimously rejected the irrationals, arab mathematicians, since the pioneering work of al-Khwarizmi's Book of algebra, accepted the irrationals as numbers throwing into confusion the narrow classical understanding of the concept of number. Much ahead of theoretical research, the rapid development of mathematical practice since the ninth century has shown that the definition of number should be updated and its understanding clarified. It is in this context that Ibn Sina has carried out his major investigation into the foundations of

mathematics. In his paper "Philosophy of mathematics", Roshdi Rashed explains how Ibn Sina's *al-arithmatīqī* radically shook up the ancient classification of the four mathematical disciplines with the aim of making them independent of natural philosophy: "from now on, he concludes, all the ontological and cosmological considerations which burdened the notion of number are de facto banned from *al-arithmatīqī*, considered thus as science." Ibn Sina's main objective to make arithmetic a pure science independent of natural philosophy is only the beginning of the story. But by what means? Here is the crux of his argument: 1) numbers are objects: this is their function in mathematical practice; 2) since they have no existence in the outside world, they exist in our mind not as real but simply as intentional objects. And the tough question in this regard is: how can a number such as 7 e.g. be an object of the mind? Or more generally what does it mean for pluralities to be the object of an intentional act? I shall investigate the answer given by the author of *al-Shifa'* to these questions and examine to what extent it can be compared to some of the various attempts made by the 19th century mathematicians and philosophers.

Discussion

To cover (a) paper of Dimitri Gutas, 'The empiricism of Avicenna', *Oriens* 40 (2012) 391-436 (to be circulated); (b) future activities of the Arabic Logic Commission.

S012-B. Foundations of science from Avicenna onwards

Thu 25 July, 11:10–12:40 ▪ Roscoe 1.010

Chair: Ahmed HASNAOUI | CNRS / Université Paris-Diderot, France

Wilfrid HODGES | British Academy, United Kingdom

An eleventh-century proof search algorithm

In the early 11th century Ibn Sīnā was teaching his students a recursive algorithm for finding completions of incomplete proofs. In section 9.6 of *Qiyās* (from his *Šifā'*) he gives the algorithm in enough detail to allow translation into an abstract state machine [2], and he promises a fuller account in his 'Appendices' (now lost if they were ever written). At one point the algorithm relies on an oracle for surveying existing knowledge, where similar modern algorithms normally backtrack through a list of axioms given in advance [1]. The algorithm might be the world's first significant non-numerical algorithm. Ibn Sīnā shows no awareness of any connection to numerical algorithms known in his time, and (unlike Al-Khwārizmī in the 9th century [3]) he makes no attempt to verify the correctness of the algorithm. [1] Egon Börger and Dean Rosenzweig, 'A mathematical definition of full Prolog', *Science of Computer Programming* 24 (1995) 249-286. [2] Wilfrid Hodges, 'Ibn Sīnā on analysis: 1. Proof search', in *Fields of logic and computation: Essays dedicated to Yuri Gurevich on the occasion of his 70th birthday*, ed. Andreas Blass, Nachum Dershowitz and Wolfgang Reisig, Springer Lecture Notes in Computer Science 6300, Berlin 2010, pp. 354-404. [3] Roshdi Rashed, *Al-Khwārizmī, Le commencement de l'algèbre*, Blanchard, Paris 2007.

Otman EL MERNISSI | Chspam-SPHERE/UMR8163 STL, Lille 3, France

Avicenne et la question du sujet de la logique

C'est dans un texte de la *Métaphysique* du *Šifā'* (en I.2) qu'Avicenne énonce la thèse célèbre selon laquelle ce sont les intentions intelligibles secondes qui constituent le sujet de la science logique. Il s'agira de déterminer les passages du corpus avicennien qui permettent de préciser la distinction entre les intentions intelligibles premières et les secondes ; seront étudiés en ce sens les textes du *Madḥal* (I.2-4 notamment) qui, bien qu'ils ne nomment pas les intentions secondes, en donnent une description et une définition : ce sont les accidents ou

modifications qui adviennent aux intentions premières lorsque l'on passe de quelque chose de connu à quelque chose d'inconnu, c'est-à-dire lorsque l'on effectue une opération logique. Si cette distinction entre intentions premières et secondes, ainsi que le fait que les secondes constituent le sujet de la logique, sont deux éléments déjà présents chez Al-Fārābī (Cf. *Kitāb al-ḥurūf*, I.3-5), nous verrons qu'Avicenne se distingue de ce dernier en deux choses au moins : Al-Fārābī continue de poser, avec la tradition qui le précède, que ce sont les expressions en tant qu'elles désignent les intentions qui constituent le sujet de la logique, tandis qu'Avicenne rompt radicalement avec cette position traditionnelle ; Al-Fārābī ne paraît pas poser la question du sujet de la logique en la rattachant au problème classique de savoir si la logique est une partie ou un instrument de la philosophie, tandis qu'Avicenne paraît, dans un même geste, déterminer le sujet de la logique et examiner la position de celle-ci dans la classification des sciences théorétiques. Mais si la logique a pour sujet les intentions secondes, et qu'elle est une partie de la science qui a pour sujet les étants en tant qu'ils sont dans l'esprit (*dīhn*), il reste encore à donner un contenu à cette thèse, qui demeure abstraite. Nous proposerons donc l'ébauche d'une liste des textes et doctrines d'Avicenne qui permettent de donner un contenu à cette thèse — notamment : la perfection des syllogismes de la première figure et l'exclusion de la quatrième figure du syllogisme, le cas problématique du concept de *ma'nā* qui intervient dans le commentaire du chapitre premier du *Peri Hermeneias*, la théorie des degrés d'assentiment. Ces doctrines ont ceci en commun qu'elles semblent converger vers quelque chose comme la constitution d'une philosophie de l'esprit. Il faudra veiller à ne pas confondre celle-ci avec la psychologie, ou plus exactement la noétique du *De Anima*.

Riccardo STROBINO | University of Cambridge, United Kingdom

Logical consequence in Arabic logic

In this paper I shall be concerned with the notion of logical consequence in the tradition of Arabic logic. In particular I shall look at how one of the central figures in the history of Arabic logic, Ibn Sīnā (d. 1037), deals with this topic and discuss how his idea of what it is for something to follow from something else is related to an elaborate account of modality and grounded in the more general framework of his theory of predicables. The focus of my analysis will be on various accounts of inseparability and the way in which they yield progressively stronger notions of logical consequence. In doing so, connections with earlier (Al-Fārābī, d. 950) and later (Post-Avicennan logicians until the XIIIth century) developments will be also sketched.

Khaled EL-ROUAYHEB | Harvard University, United States

'The Rules of Inquiry' and the ideal of verification in the Ottoman Empire, 1600-1800

The science of the "rules of inquiry" (*ādāb al-baḥth*) has received little modern scholarly attention. Though influenced by Aristotelian topics and early Islamic juridical-theological eristic (*jadal*), it only emerges as a full-fledged science in the course of the 13th century. My paper will argue that (1) there was a dramatic increase in interest in this science in the 17th and 18th centuries in the Ottoman Empire, (2) the discipline itself was developed in noticeable ways by Ottoman scholars in this period, and (3) that the discipline was widely seen as central to the widely held ideal of "verification" (*taḥqīq*), i.e. the critical evaluation of received scholarly opinions in the rational sciences.

S014. Fossil work: making paleontological specimens and knowledge

Thu 25 July, 09:10–12:40 ▪ Roscoe 2.5

Symposium organisers:

Oliver HOCHADEL | Institutió Milà i Fontanals, Spain
Caitlin WYLIE | New Jersey Institute of Technology, United States

Symposium abstract

We will consider fossils as objects of work for many different actors in vertebrate paleontology. Fossils are "located" at the crossroad of fieldwork and laboratory work, of scientific interpretation and technical preparation, and also of scientific knowledge and public communication of science. Therefore a variety of actors work with fossils, using diverse techniques to achieve many different purposes. These groups include the excavation team who find and unearth fossils in the field; the preparators in the laboratory who free them from the rock matrix, repair broken parts and reconstruct missing pieces; the paleontologists and paleoanthropologists who interpret and publish them; the museum curators and conservators who catalogue and exhibit them; and the paleoartists who use them as the basis for reconstructions of dinosaurs, saber-toothed cats and Neanderthals.

However, methods of collecting, preparing, preserving, studying, and displaying fossil specimens are rarely standard. Thus fossils reveal the complexities and skill of retrieving natural objects and making them into useful objects of research and display. These practices of collection, preparation, storage, research, and display have major implications for the construction of paleontological knowledge and the public's perception and understanding of that knowledge. Although these practices are rarely described in research publications, the ways fossils are worked on crucially determine the form of data for researchers and of display specimens for the public.

This session will look at the practices and the practitioners working with fossils. We approach fossils as products of decision-making, such as the prioritization of scientific research interests and institutional funding capabilities, professional ethics such as conservation principles, aesthetic goals for reconstructions and display, and social hierarchies among fossil workers (e.g., between paleontologist and preparator, or museum curator and paleoartist). Together, our papers will address the effects of practitioners' diverse training, backgrounds and individual motivations and interests on scientific practice, knowledge-making, and communication to the public. Through both historical and sociological case studies of past and current paleontology field sites, laboratories, collections, artists' workshops, and exhibitions, we offer a new perspective on the skillful, local, and decision-laden work of producing fossils and thus of producing knowledge about past life.

S014-A

Thu 25 July, 09:10–10:40 ▪ Roscoe 2.5

Chair: Marianne SOMMER | University of Lucerne, Switzerland

Pierre-Louis BLANCHARD | University of Lucerne, Switzerland

How 'primitive peoples' were made into 'living fossils' in the collecting practices of the Natural History Museum in Basel, 1905-1918

As has been amply shown, the scientific curiosity about 'exotic' people in biological anthropology has partly been motivated by their supposed status as 'living fossils'. Racial hierarchies established by anthropologists drew on phylogenetic theories of how today's people relate to each other. However, while this has become common knowledge, the actual practices associated with these conceptions have not received sufficient attention. In my paper, I will show how such theoretical assumptions were an outcome of and structured the activities of collecting and analysis. In the early 20th century, collection practices

of anthropological institutions brought together fossils from early- and pre-humans, prehistoric skeletons, as well as human remains from extant 'primitive races' from all around the globe. These different types of remains were part of a common data set for the development and testing of theories of human origin and human diversity. Fossils and non-fossils were differentiated with regard to age and diagenetic processes, but not regarding scientific theorising. Human 'living fossils' were made into epistemic objects for theorising on human phylogeny and diversity to the same extent as fossils *sensu stricto*. In my paper, I will develop this conclusion for the example of the anthropological collections of the Natural History Museum in Basel, Switzerland, from 1905 to 1918. In the case of the Basel museum it can be shown how the 'pygmy hypothesis', i.e. the theory that today's humans descended from a small-statured 'race', fuelled anthropological research. Already equipped with the general notion that 'primitive' peoples are living fossils, on their expeditions, Fritz and Paul Sarasin, two anthropologists from Basel, attempted to verify the 'pygmy hypothesis'. In this endeavour, the Veddahs of Sri Lanka and the Toála of Sulawesi caught their particular attention. Both were small-statured peoples the Sarasins perceived as 'primitive' culturally as well as biologically. They conceived of them as the remnants of an ancestral 'pygmy race'. I will analyse the process of constitution of this supposed ancestral human form to bring to light the interpenetration of the practices of collecting and the studying of collections with notions about human history and diversity.

Miquel CARANDELL | Universitat Autònoma de Barcelona, Spain

A donkey, not a monkey: the 'Orce Man' controversy and its construction through labs and media

In Human Origins research, remains are difficult to find and scarce. When a fossil appears, scientists tend to highlight its value both in scientific publications and mass media. At the same time, they tend to restrict the access of other scientists to the fossil. Thus, the attention of the media and the control over bones determines the way knowledge is produced in paleoanthropology. Therefore, an appropriate analysis of the spaces and actors involved in these processes seems crucial.

In 1982, a cranial fragment that seemed to be from a hominid was found in Venta Micena, an excavation site in Orce, Granada (Spain). Although the internal part of the bone still adhered to the rock, the discovery was published in a Spanish paleontological journal and presented at a press conference. The bone was around 1,4 million-years-old and it might have been the "First European", so it had a great impact in the Spanish media. In the course of the following year, the fossil was cleaned in the Museu d'Arqueologia de Catalunya, in Barcelona. After the removal of the matrix a crest appeared. This anatomical feature would be highly unusual for hominids. Therefore the fragment was attributed to a donkey. This new interpretation was reported for the first time by the newspaper *El País*. A very harsh controversy began; innovative and classical studies were applied to the fossil that appeared in numerous scientific papers and news items in the course of the next 20 years.

In this paper, I aim to show how "The Orce Man" (and "the Orce Donkey" as well) was "constructed" by different actors (experts, museum restorers, journalists, the public...) along excavation sites, laboratories and scientific and popular media. I also want to emphasize how the fossil itself played a central role in the struggle of its discoverer Josep Gibert to have it recognized as hominid.

Allison KSIAZKIEWICZ | University of Cambridge, United Kingdom

Dinosaur display at the Royal Tyrrell Museum

This paper examines the relationship between the viewer and the portrayal of deep time in the Royal Tyrrell Museum in Drumheller, Alberta. Using examples of deep history representation, this paper demonstrates how and why the museum tour is successful and critically

deconstructs the display mechanisms employed in the galleries. The majority of the discussion revolves around Dinosaur Hall, the museum's main attraction, and its dioramas. In particular, the unique treatment of the *Prosaurolophus* display is addressed: a full-length mirror behind the mounted specimen incorporates the viewer into the display proper. The result is an unusual but highly effective narration of prehistoric history that oscillates between the visibility and the invisibility of the viewer, so that the visitor is engendered as both a passive and an active participant in the construction of deep time in the museum. The regular juxtaposition of the human viewer with the mounted skeletons in Dinosaur Hall guides the visitor to reflect on their own position within the history of the earth. I argue that this display technique effectively contributes to the success of the museum tour.

S014-B

Thu 25 July, 11:10–12:40 ▪ Roscoe 2.5

Chair: Marianne SOMMER | University of Lucerne, Switzerland

Margit BERNER | Natural History Museum, Vienna, Austria

Cast collections in physical anthropology and museums work

Hominid fossils usually represent rare and precious museum and university collection items. Since the discovery of the first hominid fossils in the mid-19th century, it became common to cast and distribute copies of such rare findings, which allow other researchers the comparison of morphology. Based on the example of the cast collection of the Department of Anthropology of the Natural History Museum in Vienna, this presentation tries to explore the history of collecting, studying and use of the cast collection.

Before a cast of a fossil can be created, a variety of processes of cleaning, preparation and restoration are necessary. In some cases, pieces or parts of the skull are separately casted allowing different reconstructions of possible orientations and places of the pieces in the skull. For studying details or inner structures of the cranial vault special techniques to produce endocasts had been developed. High quality casts of teeth are often used for scanning electron microscopy (SEM) research.

Molding of an original fossil is a very sensitive and time consuming process and usually performed by specialized trained and skilled preparators as well as by scientists themselves. Techniques and materials for casting changed over the time. Whilst earlier molds and casts are produced predominately in plaster of paris, new high accurate materials such as silicon and resins are used. New techniques like 3D laser scanning and 3D models of CT image data allow further 3D laser printing of the digital objects.

Casts, however are not only an important source in research, they are favored objects in teaching and exhibiting human evolution and many museums and university institutions set up special collections of casts. In the last century various associations, museums and companies had started programs to make such specimens available to teaching and exhibiting.

Caitlin WYLIE | New Jersey Institute of Technology, United States

'Invisible technicians' in today's paleontology laboratories

Paleontology laboratories are crucial sites of specimen production and therefore knowledge production for fossil-based research. However, the work and workers of these labs are rarely described in publications, or even in lab records. The processing of fossils into specimens is called fossil preparation and is primarily done by fossil preparators, who learn their skills on-the-job. Preparation involves removal of rock matrix and repair and reconstruction of fossils, but techniques are diverse, often

adapted, and largely unrecorded. Steven Shapin argues that omitting workers, such as technicians, from research reports makes them and their practices “invisible” – unknown and unrecognized. Considering why preparators and their work are “invisible” in scientific publications reveals the implicit foundations of both practice and social order in scientific workplaces. To investigate the invisible people and unwritten practices of fossil preparation, I interviewed, observed, and collected survey responses from workers in paleontology laboratories in the United States and the United Kingdom. These data reveal how scientific work depends on nonstandard practices and informally-trained people. Unlike studies that point to benefits for researchers of the invisibility of laboratory work and workers – i.e., to make knowledge claims appear more credible – this case suggests benefits for technicians of being overlooked, namely the preservation of workers’ power over their practices. Science can thus be understood as work done by a community – locally contingent and crucially based on conceptions of skill and status.

Oliver HOCHADEL | Institució Milà i Fontanals, Spain

Resurrecting the remains: how paleoartists reconstruct hominids

Nowadays there is hardly a natural history museum without a fully-fledged reconstruction of a hominid. Often it is a “Lucy”, the famous *Australopithecus afarensis* found in Ethiopia in 1974. More recently some museums even boast the “entire family”, i.e. a dozen or more three-dimensional reconstructions of different hominid species (full-body sculptures or busts). Two-dimensional renderings of Neanderthals or *Homo erectus* greet from the covers of National Geographic and other popular science magazines. But even in *Science* and *Nature* reports about new hominid finds in Africa or Asia are more often than not accompanied by a drawing of how this creature might have looked like.

The visualization of hominids have already received a good bit of scholarly attention. Moser, for example, pointed out that “the image is more than a summary of data, it is a document which contains a theory” (Moser 1992, 837). Moser (1998) also showed how limited (and stereotypical) the visual vocabulary in the rendering of early (“primitive”) humans was and still is.

Building on these scholarly works this paper aims at the concrete practice of this work with fossils. It is based in part on interviews with the paleoartists themselves, the paleoanthropologists and the curators of the museums who commissioned the reconstructions. Worldwide there are only very few paleoartists. Who are these people? What kind of training did they have? Do they perceive themselves as artists or as scientists?

The paper will explain how these sculptures are actually manufactured (“reversed dissection”). What methods do the paleoartists use? Soft tissue does not fossilize. How do the paleoartists fill the “gaps” of the paleontological record, e.g. hair and skin? How “speculative” are the drawings, busts and full-sized reconstructions of early humans? Which iconographic traditions influence the representations? Particular attention will be given to the collaboration between between the paleoartists and the paleoanthropologists supervising their work. How do they interact? And how do they resolve conflicts in the production process?

The field of human origins research is well known for its often heated phylogenetic debates. In how far are these controversies reflected in the reconstructions? Do the sculptures of an *Australopithecus* or a *Homo erectus* also influence the views of the researchers themselves? The paper will argue that the paleoartists do in fact produce some kind of new knowledge.

Peter C. KJÆRGAARD | Aarhus University, Denmark

Building an ancestor: the politics and practices of hominin reconstructions

Owing to a series of new fossil finds, archaeological discoveries, advances in genetics, including studies of ancient DNA, and an increase of climatic data, our understanding of hominin evolution has changed

drastically over the past couple of decades. The fairly neat picture of human evolution in the 1990s has turned into a far more complex story challenging a number of preconceived notions about species, dispersals, and lineages. All the new data has gradually worked towards replacing a linear evolutionary representation as a favoured theoretical model by a more bush-like understanding of human evolution. This has a critical impact on hominin reconstructions and how they are constructed as ancestors or relatives in scientific discourse as well as in public representations at museums, publications and documentaries. Their outlook change, how we see them and how they are mirrored in our own image change. Contemporary hominin reconstructions by palaeoartists reflect this. Crucial to this kind of reconstruction work are the bones that form the palaeoanthropological record of hominin evolution. Specialized knowledge from genetics, anatomy, and physiology about soft tissue, hair, skin colour, eyes, etc., sometimes constituting consensus and sometimes not, come from publications and communications with members of the scientific community. Fossil data is also published. But fossils are different. Extremely rare and often the topic of highly politicized claims of ownership and heritage restricting direct access for researchers and artists, bones are reconstructed in a number of different ways informing both science and art. Original casts are often as difficult to work on as the fossils themselves. Consequently, commercial casts made by companies play an unnoticed role in interpretations, even though they are themselves not necessarily based on neither originals nor original casts. Digital data is guarded with equal cautiousness as original fossil material, and only published with limited information. Palaeoanthropological data is thus constructed in a complex social and epistemic network of interest groups with different agendas. In this paper I will analyse the changes in hominin reconstruction in recent history, and discuss how the complex negotiations between scientific, commercial, and artistic visualizations generate what we think we know about the looks of human ancestors.

S015. Novel expertise and emerging specialists

Wed 24 July, 09:00–12:30 ▪ Roscoe 1.009

Symposium organisers:

Sean F. JOHNSTON | University of Glasgow, United Kingdom
Terry SHINN | GEMAS/CNRS, France

Symposium abstract

The expansion of science, technology and medicine inevitably extends specialist knowledge and the working identities of experts associated with it. Emerging technologies and evolving fields can entrain new breeds of specialist who cross disciplinary boundaries or create entirely new knowledge. The successful establishment and consolidation of these specialists is often a combination of intellectual innovation and fertile social context.

Such themes were hinted a half century ago by Thomas Kuhn’s *The Structure of Scientific Revolutions* (1962), and explored by subsequent sociological studies of scientific communities. Research on technical expertise and cultural identity has further broadened the scope of scholarship, and case studies in history of science, technology and medicine have the potential to enrich the evidence much further.

This symposium of the 2013 International Congress on the History of Science, Technology and Medicine (ICHSTM) in Manchester will be dedicated to exploring the relationship between evolving intellectual frameworks, material resources or skill sets, on the one hand, and occupational, disciplinary or professional identity, on the other. Presentations may include current researches, case studies or reflection on methodological approaches.

Among the possible questions to be addressed are:

- How have new scientific fields or technologies emerged, and what qualities have their key champions and supporters had?
- Why, when, where, and how have novel working identities been shaped?
- How have members of existing fields adapted to shifts in content, perspective or technique?
- What intellectual and social processes govern the division or redirection of a field?
- How has recognition for the new expertise been negotiated?
- What distinguishes 'successful' from 'unsuccessful' intellectual identities?

The chronological period and intellectual field are open. Cases of science, technology and medicine drawn from the period of accelerating professionalization (late 19C to the present) are particularly welcome.

30 minutes will be allocated to each speaker for presentation and questions.

S015-A

Wed 24 July, 09:00–10:30 ▪ Roscoe 1.009

Chair: Terry SHINN | GEMAS/CNRS, France

Sean F. JOHNSTON | University of Glasgow, United Kingdom

The Goldilocks profession: defining the nuclear engineer

Between the 1940s and 90s, successive generations of nuclear specialists found themselves defined by conflicts. Their new expertise drew on both high physics and engineering heuristics. Their evolving jobs were defined alternately by the corporate industrial cultures of chemistry and of electrical engineering. And, despite the exuberance of the atomic age, their professional status and collective authority vascillated. Veiled by security, their new knowledge was guarded in national laboratories. Unlike their predecessors, the disciplinary borders, occupational roles and public status of nuclear engineers were defined largely by the State. As power generation developed as the principal application, nuclear engineers populated more stable job categories as designers and operators of reactors. But as ill-defined and often faceless experts, these practitioners' characteristics became subsumed by those of corporate sponsors. In latter decades, these expert practitioners were delineated more often by accidents than by achievements. This paper examines factors shaping technical identity and argues that, as members of a perpetually 'in-between' or 'Goldilocks' profession, nuclear engineers had remarkably limited influence in defining their own identity. Based on archival and oral history research in the UK, USA and Canada and comparisons with earlier national studies, the history of their emergence can be characterised as transnational and yet largely transcending politics at the national scale.

Elisa CAMPOS | Universidade Nova de Lisboa, Portugal

Emerging studies of lipoproteins in clinical practice, 1949-1977

Lipoproteins emerged and developed in consequence of the interest they awakened in public health and clinic.

By the beginning of XX century in the US, statistics indicated an increase of coronary heart disease (CHD), but the cause-effect model applied to infectious diseases was not applicable to heart disease. While the American government decided to outline the Framingham Heart Study (FHS), under the aegis of the National Heart Institute (NHI) from 1948 onwards, Gofman, in Berkeley, with the analytical ultracentrifuge elucidated the form of transportation of lipids in circulation, thus opening a new representation of lipoproteins; in 1949 he reported that Low

Density Lipoproteins (LDL) are increased in patients who suffered a myocardial infarction.

Following Gofman's reports, NHI recruits young physicians who establish a bridge between research and clinic. Among them, Fredrickson stands out by his classification of hyperlipoproteinemias, endorsed by the World Health Organization, in 1970, popularizing phenotyping among physicians. Electrophoresis on paper allowed an important clinical application.

LDL, putative risk factors for CHD since 1950, were so confirmed, in 1977, by the FHS.

Alaupovic, arriving to this field in 1960s, put the emphasis on the protein moiety of lipoproteins, isolating a 3rd apolipoprotein, Apo C; he redefined the concept of lipoprotein, stressing the role of apolipoproteins in the atherosclerotic process.

Some laboratories force a change in itinerary to the other labs—new apolipoproteins could not be ignored. The rulers of NHI were constrained to integrate them in canonical knowledge, in 1973. Why? because the laboratories involved shared a common culture and apolipoproteins contributed to the elucidation of biochemical mechanisms of hypercholesterolemia.

Members of existing fields adapt to shifts in content, perspective or techniques because scientists' goals and resources are defined in a process of interaction with scientific objects, other scientists and actors operating in various institutional settings.

Finally, success of scientists who reconfigure disciplinary matrixes also depends on captivating young disciples to further develop their research, a strategy followed by the scientists involved in lipoprotein's studies; besides, they exercised influence through collaborations with clinicians, opening up new avenues in the practical application of the determination of lipoproteins.

Susana FRANÇA DE SÁ | Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa; MUDE - Museu do Design e da Moda. Colecção Francisco Capelo, Portugal

Looking for the founders of the polyurethane industry in Portuguese furniture design

This work aims at studying the history of Portuguese industrial production and processing of polyurethane and its application in furniture design. It intends to answer questions like: when and how did it start? Who were its founders? What was the academic education/professional training of people involved? What kind of technology was being used? And how was that technology acquired? Since this study has no parallelism at the national level, it is crucial to investigate in libraries and factory archives in order to collect information about the origin of Portuguese polyurethane production and to understand if importation, industrial espionage or partnerships were being done. Taking Portuguese objects from MUDE – Museu do Design e da Moda. Colecção Francisco Capelo (Lisbon) as case-studies, this research looks at these creations through the history of polyurethane technology. It also intends to complement previous works about Portuguese design with novel knowledge about the industry and use of this recent material (developed in 1937, by Otto Bayer in Germany). In the context of Portuguese industry and with the active participation of Estado Novo (dictatorship regime), it was not before the 1950s that its mass production began. With a strong desire for innovation, Portuguese factories started to include design as an essential part of their work and even without being part of academic training, design gained a high status. With regard to plastics production, the first objects (made with Bakelite) appeared in exhibitions of Portuguese industry in the 1930s; after the sixties, the first industrial units working with polyurethane started appearing. Among these factories, Flexipol (1964, São João da Madeira), Eurospuma (1965, Espinho), Têxtil Manuel Gonçalves (1960-70s, Guimarães), Endutex - Soc Revestimentos Têxteis (1970s, Caldas de Vizela) and Fábrica de Calçado Campeão Português, SA (1970s,

Guimarães) were identified during this investigation as producers of PU foams, coatings and shoe soles. In which concerns furniture factories it was also found that Metalúrgica da Longra and Fábrica Osório de Castro, some of the most important furniture factories in Portugal, may have assumed an important role in the incorporation of polyurethane in the design of national furniture objects. In this way and unlike the common notion of an industrially backward Portugal, this research has been showing Portugal has a place on the map of polyurethane industrial processing.

S015-B

Wed 24 July, 11:00–12:30 • Roscoe 1.009

Chair: Sean F. JOHNSTON | University of Glasgow, United Kingdom

Anne MARCOVICH | GEMAS/CNRS, France

Terry SHINN | GEMAS/CNRS, France

Quantum dots: the making of contemporary genericity in science and technology

This talk identifies conditions under which a cognitive/technical object becomes an expression of genericity. The generic status of Quantum Dots (QD) in nanoscale science and technology is today a combinatorial product of four components: 1. the concept of confinement; 2. specific physical objects originating in material science technologies and related experimentation work; 3. the classification of related substances having similar dimensional characteristics into a single closed category; 4. development of downstream market consumables. The concept of quantum confinement in semiconductor materials emerged during the 1970s and acquired a measure of theoretical and soon experimental strength during the 1980s. Quantum confinement refers to the modification of electron-exciton properties within a material smaller than the dimensions required for unfettered behaviour; in the case of electron and excitons, the space is in the range of about 2 nm. Unusual electronic and optical behaviour is observed in such a dimension which does not exist in the natural world. The physics of quantum confinement is linked to the development of zero, one and two dimensional objects which were synthesized for the first time in the 1980s and 90s through the introduction of new technology. Genericity cannot be established on the basis of a single species of object or instrument. It must associate a number of material substances sharing foundational characteristics. The Quantum Dot, a zero dimensional object, belongs to a larger, general category termed "low dimension systems" that includes nanowires (one dimensional) and the nano well and nanotubes (two dimensional). Finally, nowadays quantum dots have become increasingly important devices in opto-electronics, biophysics and in solar energy due to their nanostructured innovative behaviour and capacity. One observes here that QDs extend vertically through the research concept, research object and research tool axis, and that they extend horizontally across multiple domains of the consumer market axis. The development of genericity is a historical process mobilizing a heterogeneous complex of combinatorials. We suggest that QD as a generic material is a consequence and conjunction of quantum confinement theory, low dimensional materials and a species of research objects comprises a pivot of genericity inside nanoscience and technology, and that this genericity both fuels the nano field and constitutes one of its key signatures.

Johannes LENHARD | University of Bielefeld, Germany

Disciplines, models, and computers: the path to computational quantum chemistry

The digital computer is an instrument which is in use in most, if not all, scientific fields and disciplines. Hence one can ask in what ways these disciplines have been affected. This talk wants to investigate how the organization of expertise, the conception of computational models, and computing technology bond to each other. The claim is that if one wants

to specify this bonding, computational technology crucially matters - in particular the differences between big mainframe machines - which slowly came in use from the mid 1950s onwards - and smaller, networked computers that kickstarted around 1990. To specify this claim, I will concentrate on the case of quantum chemistry. Two phases will be discerned. The first leads to the establishment of quantum chemistry as a sub-discipline of chemistry. This process has been well-researched by M. Nye, K. Gavroglu, A. Simões, among others, who acknowledge the important role that the digital computer played for making quantum chemistry computationally feasible. However, this role does not follow a mathematical necessity, rather is subject to change. I want to discuss how the mainframe type of computer was related to a particular way of organizing expertise. The main issue of my talk will be the turn from quantum chemistry to computational quantum chemistry (CQC) that took place around 1990. In particular, so-called density functional theory will be investigated that came to play a major role in connection with CQC. It will be argued that the technology of lab-scale, networked computers links to a new "combinatorial" conception of computational modeling and to a market-like organization of CQC-expertise. The process of augmentation discussed here - turning quantum chemistry into "computational" quantum chemistry - might be seen as exemplifying parallel developments where other scientific fields are becoming "computational".

Arnaud SAINT-MARTIN | CNRS / Université de Versailles, France

Satellites, maps and managers: establishing a space-based natural disaster observation and terrestrial local intervention system

In this talk, I will present some results of a survey on the conception and the uses of a space System, the International Charter "Space and Major Disasters". Initiated in 1999 by the French and European space agencies (CNES and ESA) (and subsequently joined by a dozen other national space agencies), this innovative satellite system is designed to assist the "management" of impacts of major disasters, such as earthquakes, volcanic eruptions, floods, tsunamis, cyclones, fires, or oil spills. The space agencies and partner organizations (data providers, rapid mapping services) operate a constellation of Earth observation satellites (e.g. SPOT) immediately following a disaster; this body generates free of charge cartographic products based on satellite images (e.g. before-and-after maps used to depict the extent of the damage) that will be transmitted to authorized end users (civil protection agencies, NGO, etc.) for rescue operations. Since 1999, the Charter was activated during major disasters, like Katrina, the 2010 Haiti earthquake, the 2011 Japanese tsunami, and very recently during Hurricane Sandy. But these rapid cartographic satellite data based products are not the only outputs of the Charter. New functions were progressively tested (risk assessment and anticipation models, simulations of disasters, and geographic information systems), which demonstrates the plasticity and adaptability of the system. How is satellite information acquired and formatted? How is this collective activity distributed during an emergency operation? How is the "responsiveness" of this satellite system planned and organized? What kinds of mechanisms regulate the circulation and uses of these data? I will give some answers to these questions by combining a multiplicity of information (interviews, direct observations of activations, technical documentation, etc.). I will show how various dimensions (technical, organisational, socio-economic, and political) are articulated within the system. It will be argued that the Charter (among other examples) reveals a marginal but informative reconfiguration of the previously well-established jurisdiction of space activities and expertise, which is increasingly engaged in the fields of biosecurity and ecological engineering.

Patrick MCCRAY | University of California, Santa Barbara, United States

Learning to share: modern astronomers, data, and networks

Starting in the 1960s, astronomers' view of the sky shifted from an analog perspective in which data was recorded using photographic plates and strip charts to one wholly mediated by digital technologies. By the early 1980s, astronomers expressed growing concern about having to deal with a deluge of data that was increasingly "born digital." Data management became one of the modern astronomers' necessary tasks as astronomy itself transformed into a particular form of "information science." This transition presaged today's debates about Big Data and the archiving of massive data sets in astronomy and other sciences which researchers mine. This paper explore two episodes in this historical process using astronomy as an example. Both center around scientists' wish to share data and data processing tools with their colleagues. The first episode concerns the emergence of the Flexible Image Transport System or FITS. This is a common data format developed by scientists at national observatories in the U.S. and the Netherlands and accepted as an international standard in 1982. The second example is STARLINK, a sophisticated computer network for sharing and manipulating digital astronomical images that debuted in the United Kingdom in 1980. In both cases, astronomers' desire to share digital data speaks to broader changes in researchers' moral economy as the availability of new technologies challenged traditional norms and encouraged the formation of common formats, standards, and tools.

S016. Image-making and knowledge-making in early-modern Europe

Tue 23 July, 14:00–17:30 ▪ Roscoe 1.007

Symposium organisers:

Sven DUPRÉ | Freie Universität Berlin / Max Planck Institute for the History of Science, Germany

Sachiko KUSUKAWA | University of Cambridge, United Kingdom

Symposium abstract

This symposium focuses on the relationship between graphic and painting skills/products and the formation of knowledge in early modern Europe. It is particularly interested in the process of image-making, the role of image-makers in knowledge-formation and dissemination, and how the material production of images in art and science interacted with the development of bodies of knowledge. This addresses the congress theme of 'Knowledge at work' on several levels, by attending to the role and status of 'artists' and 'artisans', the function of images (both manuscript and printed) in communication about science, and the relationship between knowledge-making enterprises described as 'science' and those that are not.

S016-A. Images at work

Tue 23 July, 14:00–15:30 ▪ Roscoe 1.007

Chair: Sachiko KUSUKAWA | University of Cambridge, United Kingdom

Anke TIMMERMANN | Max Planck Institute for the History of Science, Germany

Image and imagination: non-verbal generation of knowledge in early modern alchemical manuscripts

In the early modern period writers of alchemical manuscripts increasingly chose to translate their experiences, observations and thoughts into images. Visual elements (symbols, sketches, diagrams, tables and

illuminations) not only added to the terminology of alchemy and the representation of alchemical information; they also provided an instrument for the generation of knowledge. Symbols were used as a pragmatic shorthand in the production of manuscript texts; drawings of apparatus illustrated practical aspects of the art, often with mnemonic functions; the famous Lullian diagrams, circular schemes and trees, lent a structure to the underlying concepts of alchemical processes; and more elaborate illuminations often depicted the metaphorical elements of alchemical expression in a colourful, at times contemplative, way.

In the sixteenth century in particular, medical approaches to alchemy, humanistic methods of manuscript compilation and royal interests in the art prompted the production of codices with rather peculiar traits. In spite of their heterogeneous approaches to visual representations these manuscripts show a general tendency towards a distinctly post-medieval conception of manuscript space and its uses in alchemical contexts. They also, implicitly, map the development of pictorial vocabularies and conventions around alchemical theory and practice.

This paper will discuss the functions of images and imagery in a series of sixteenth-century alchemical manuscripts now held at the Austrian National Library. After an initial survey of the pictorial elements of early modern alchemy it will focus on selected examples to approach the following questions: what functions did images, as opposed to linguistic descriptions or metaphors, fulfil in alchemical, and alchemo-medical, contexts? And how did the use of non-verbal imagery shape the conceptualisation of alchemical theory and practice? A consideration of images as instruments, models, epistemic tools and mnemonic devices will be balanced with a close look at the manuscripts as objects.

Felicity HENDERSON | Royal Society, United Kingdom

Robert Hooke and image-making in early-modern London

Robert Hooke (1635-1703) was the Royal Society's first curator of experiments and as such was central to the Society's research programme in its formative decades. He also had close ties with London's City administration, who employed him as Surveyor after the great fire. His personal diary, kept at the most active period of his life, enables a close analysis to be made of his working life and his networks of associations. As such, he is an interesting case-study for historians interested in the ways in which scientific circles overlapped with the other worlds of Restoration London. This paper will examine Hooke's associations with the painters and engravers, map-makers, makers of architectural drawings and models, sculptors, printers, craftsmen and instrument-makers who produced the visual culture of Restoration society. It will chart the extent and nature of Hooke's relationships with these people, in particular noting points at which exchanges of information took place. I will go on to suggest some ways in which Hooke's interactions with image-makers may have influenced, or been influenced by, his work for the Royal Society. A rich variety of image-making processes were available to the early experimental philosophers, yet some were utilised much more frequently for scientific purposes. This paper will attempt to show how individuals such as Hooke mediated between the world of visual culture and the largely oral and textual setting of the early Royal Society.

Anna Marie Roos | University of Oxford and the University of Lincoln, United Kingdom

Shell game: knowledge at work in Martin Lister's *Historiae Conchyliorum*

The bibliographic history of Martin Lister's *Historiae Conchyliorum* (1685-1692) is a complex one. This work, the first comprehensive work on conchology, went through several draft and partial editions. In 2012, one of Lister's workbooks for the *Historiae* was rediscovered in the Bodleian Library, as well as four boxes of Listeriana in the Sackler Library. These primary sources further illuminate the techniques that Lister and his daughters utilized in constructing the *Historiae*, as well as the methodology they used to arrange the images of the shells for taxonomic

purposes. Lister's workbook also contains original drawings created for relevant articles that he wrote for the Philosophical Transactions of the Royal Society, and I will briefly put these images into their historical context.

Commentary: **Sven DUPRÉ** | Freie Universität Berlin / Max Planck Institute for the History of Science, Germany

S016-B. Colour matters

Tue 23 July, 16:00–17:30 ▪ Roscoe 1.007

Chair: **Sachiko KUSUKAWA** | University of Cambridge, United Kingdom

Marjolijn BOL | University of Amsterdam, Netherlands

Gems, gold, glass and drying oils: the imitation and representation of light in practice and theory, 1250-1500

In pre-modern times the art of enameling, (stained) glass painting, polychromy, mosaics and oil painting all share similar optical characteristics. Artisans created translucent enamel colors on different types of metallic surfaces, enameled mosaic stones with transparent vitreous layers, made translucent stained glass windows and painted glowing glazes with oil colors. Whereas several scholars alluded to the material connections between the above-mentioned crafts, its implications for a growth of optical knowledge within the visual arts have never been explored. This paper will deal with the question of how artisanal knowledge was triggered and changed by the confrontation between and competition of diverse crafts that were optically related in the period up to 1450, finally leading to a particular and striking know-how for representing light and luster in the works of the famous Flemish painter Jan van Eyck and his contemporaries. Combining research into art technological sources, reconstructions of historical painting techniques and technical research into art objects, it will become clear how the search for lustrous effects in pre-modern crafts led to the exploration and ultimately emancipation of drying oils in the workshop of the panel painter. Finally, I will argue how the artisanal understanding of the properties of translucent and transparent materials, and the oil medium in particular, contributed to the astounding display of optical knowledge characterizing the painters of the *ars nova* in the fifteenth century. This way investigating the ways in which the history of image-making is intertwined with the history of knowledge-making, both in the exploration of the optical properties of materials and in the history of the imitation and representation of gems, gold and glass with oil paint, sheds new light on the early Netherlandish innovations in panel painting. While it is usually studied as a pictorial transformation, it can also be considered a material revolution, in which the art of painting lost its ties with the crafts that it was so closely connected to in the centuries before.

Karin LEONHARD | Max Planck Institute for the History of Science, Germany

Painted gems: British portrait miniatures and seventeenth-century colour theory

In contrast to the glazing technique of oil painting, tempera-based media as manuscript illumination and portrait miniature painting created colour hues mainly by a physical mixture of pigments or dyes on the painter's palette. The mixture ratio of painters advanced ideas about a colour specification system that could be used to specify the colour of any coloured object. Therefore, I will focus on the relation between portrait miniature painting and 17th-century scientific experiments on colour, looking into models of colour gradation and colour scales. For a long time, miniature painting lingered between the realm of goldsmithery and painting – thus combining an interest in colours in nature (gems) and colours in art (pigments).

MARGOCSY Daniel | Hunter College, CUNY, United States

The well-temper'd engraver: Newtonian optics, theories of proportion, and the invention of color printing

This paper examines the theoretical foundations of the invention of color printing in the early eighteenth century, and their importance for the development of our modern intellectual property regime. In these years, the amateur philosopher Lambert ten Kate, the entrepreneurial printmaker Jacob Christoffel le Blon, and, to a lesser extent, the classicist painter Hendrik van Limborch collaborated on an experimental research program to reform the sciences and the arts, and came to believe that the same, Pythagorean harmonies governed the structures of human body, the diffraction of white light, and all other branches of knowledge. The culmination of their research program was Le Blon's invention of color printing, an artisanal technology based on the mathematical laws of Pythagorean theory. This conceptualization of printmaking turned away from the early modern artisanal epistemologies that Pamela Smith has so eloquently discussed. While earlier artisans thought that their knowledge was embodied, and could only be acquired through long years of experience, Enlightenment printmakers like Le Blon came to sincerely believe that technological know-how could be reduced to mathematical statements. These mathematical statements could be disseminated and communicated easily; anyone could learn from a book how to do artisanal work. This was not a welcome development for artisans who earned a living from having a monopoly in their field. Le Blon considered the mathematization of artisanal work a risky proposition, because he feared that others would then be able to quickly steal and pirate his new invention of color printing. He therefore resorted to trade secrets, and also exploited, and even shaped, the emerging patent systems of the eighteenth century. My talk thus argues that the growing Enlightenment belief in the mathematization of knowledge did not give rise to the public sphere, or a Republic of Letters where knowledge was exchanged in a gift exchange. By putting artisanal knowledge on theoretical foundations, Enlightenment artisans contributed instead to the development of the modern intellectual property regime.

Commentary: **Alexander MARR** | University of Cambridge, United Kingdom

S017. Boundaries at work: producing experimental and clinical knowledge of/with epilepsy between neurology, psychiatry and neuroscience in the nineteenth and twentieth centuries

Mon 22 July, 11:10–12:40 ▪ Uni Place 3.205

Symposium organisers:

Karine LE JEUNE | Université de Nantes, France

Vincent PIDOUX | Université de Lausanne, Switzerland

Symposium abstract

Au cours des années 1870, notamment suite aux travaux du neurologue anglais J. H. Jackson, l'épilepsie est définie comme une affection chronique caractérisée par des décharges électriques excessives soudaines et récurrentes de la substance grise de certaines aires du cerveau. Principalement décrite comme le "Mal caduc" depuis l'Antiquité, l'épilepsie s'enrichit d'une description nosologique de

symptômes “ psychiques ” (hallucinations visuelles, auditives ou somato-sensorielles, etc.) auxquels sont associées des dysfonctions cérébrales localisées. La grande diversité des signes psycho-moteurs présentés par les patients épileptiques est étudiée, répertoriée et délimitée cliniquement et expérimentalement par les cliniciens-chercheurs de la fin du 19^{ème} siècle et donne lieu à un tableau clinique typique reconnaissable. La régularité et l'uniformité des symptômes épileptiques dégagées par ces travaux constituent progressivement un véritable instrument d'expérimentation scientifique et clinique au croisement de nombreuses disciplines (psychiatrie, neurologie, neuropsychologie, neurophysiologie, électrophysiologie, psychophysiology). Différents procédés visant à provoquer et à observer des crises épileptiques (lésion cérébrale, administration de substances, stimulation lumineuse intermittente, hyperventilation) sont introduits comme moyens de diagnostiquer une épilepsie, de mettre à l'épreuve son uniformité clinique, de dégager des seuils entre troubles neurologiques et psychiatriques, mais également dans le but de produire des connaissances plus générales sur les rapports entre états pathologiques du sujet et fonctionnement cérébral. À l'aide de ces épreuves cliniques et expérimentales et notamment à l'aide de l'électroencéphalogramme mis au point au cours des années 1920 et 1930, l'épilepsie devient une maladie qui attise les espoirs d'un accès à une explication physiologique des phénomènes psychiques. À partir de contextes spécifiques, les contributions de ce symposium examinent les interactions concrètes entre savoirs, pratiques et techniques produits et mobilisés par et pour l'étude clinique et expérimentale de l'épilepsie. Elles interrogent la manière dont s'intriquent expérimentation et clinique, théories et savoir-faire, en portant une attention particulière aux frontières et aux seuils qui sont au cœur du travail clinique et scientifique et des réflexions épistémologiques concernant l'épilepsie. En s'intéressant au travail clinique et expérimental nécessaire à la compréhension et à la prise en charge de l'épilepsie, ce symposium s'inscrit pleinement dans la thématique générale de l'ICHSTM 2013. Dans une dynamique de collaboration originale permise par ce congrès, les travaux présentés visent plus largement à interroger le statut épistémologique et le rôle paradigmatique de l'épilepsie dans la construction des sciences du cerveau de la deuxième moitié du 19^{ème} siècle et du 20^{ème} siècle.

Chairs:

Vincent PIDOUX | Université de Lausanne, Switzerland

Karine LE JEUNE | Université de Nantes, France

Karine LE JEUNE | Université de Nantes, France

Epilepsie et folie au XIX^e siècle: la théorie de l'épilepsie larvée

En 1860, l'aliéniste Bénédict Augustin Morel (1809-1873) publie dans la *Gazette hebdomadaire de médecine et de chirurgie* un article dans lequel il définit ce qu'il nomme lui-même « épilepsie larvée ». Il s'agit, d'après lui, d'« une variété non encore décrite d'épilepsie », se révélant par des symptômes de type psychique et non par des convulsions. Cette théorie de l'épilepsie larvée est beaucoup discutée lors de réunions de la Société médico-psychologique, auxquelles prennent part non seulement des aliénistes, mais également des philosophes et des juristes. L'ensemble de ces réunions, se déroulant sur plusieurs mois des années 1872-1873, deviendra une référence sur le sujet pour les commentateurs ultérieurs ; la plupart d'entre eux souligneront que l'épilepsie larvée fut adoptée à l'« unanimité ». Or, lorsque l'on étudie en détail le texte de ce débat, publié dans les *Annales médico-psychologiques*, il apparaît clairement que cette théorie engendra, certes, de l'enthousiasme, mais également de nombreuses réserves. De ce fait, pourquoi l'évoque-t-on toujours à la fin du XIX^e siècle voire même au début du XX^e siècle ? Afin de répondre à cette question, nous nous intéresserons particulièrement à l'aliéniste Henri Legrand du Saulle (1830-1886) et à sa fonction d'« expert judiciaire », ainsi qu'au contexte médico-légal inhérent au dernier tiers du XIX^e siècle.

Deirdre LEAHY | Lancaster University, United Kingdom

Conceptions of the epileptic and the hysteric from the nineteenth century to contemporary epilepsy medicine

The intimate connection between femininity and hysteria is well known, and has given rise to an abundant literature. However, up to and prior to the nineteenth century hysteria also had its counterpart in epilepsy which was constituted as a male disease. This gendered history has been successfully sedimented over with references to the masculinity of epilepsy found only in older texts. In addition, unlike epilepsy, it is a common assumption that hysteria no longer exists as a material diagnosis in biological medicine any longer and that, rather, hysteria and its gendered association is an historical anachronism.

In this paper, however, I will point to the practices surrounding the diagnosis of 'Epileptic seizure' and 'Non epileptic seizure' in contemporary epilepsy medicine and I will trace these current practices to the construction of the epileptic and the hysteric in the nineteenth century to the work of Sigmund Freud and John Hughlings Jackson. Through their work I will identify the hysteric as having been constituted as both female *and* immaterial, and the epileptic as both male *and* fully material. Crucially, I will trace this Victorian gendering and its material effects into contemporary neuroscience

Vincent PIDOUX | Université de Lausanne, Switzerland

Epilepsie et électroencéphalogramme: de la psychiatrie à la neurologie?

Dans cette contribution, je propose d'explorer le rôle institutionnel, scientifique et clinique de l'électroencéphalogramme (EEG) dans l'étude et la prise en charge de l'épilepsie, entre neurologie et psychiatrie. En Suisse, si une épileptologie se développe à partir de la fin des années 1940 grâce à l'usage de l'EEG, on doit l'introduction de ce dernier à la psychiatrie, à partir des années 1930. Tenir compte de l'apport de la psychiatrie suisse et de la lente reconnaissance de la neurologie en tant que discipline institutionnalisée met sur la voie d'une histoire d'une *clinique psychiatrique de l'épilepsie*, à travers des figures telles que Roland Kuhn ou Hans Landolt, tous deux psychiatres formés à l'EEG. J'aborde quelques travaux réalisés au cours de la période 1940-1960, notamment ceux qui ont permis à Landolt de décrire un phénomène de « normalisation forcée » de l'EEG de patients épileptiques lors de l'apparition de symptômes psychotiques. Quant à Kuhn, il inscrit l'usage de l'EEG dans un souci constant de prise en charge globale des patients, seule garantie, selon lui, d'un bon diagnostic différentiel entre différentes formes d'épilepsie et différentes expressions de troubles psychiques. Enfin, je soutiens qu'à partir des années 1960, l'EEG et l'épilepsie deviennent respectivement une des méthodes d'investigation clinique et une des pathologies privilégiées de la neurologie. Si quelques cas d'épilepsie dite « essentielle » sont toujours diagnostiqués et pris en charge dans les hôpitaux psychiatriques, plusieurs facteurs tels que le développement technique, les considérations de coûts d'hospitalisation, le raccourcissement des séjours des patients et la mise en avant d'une approche ambulatoire de l'EEG en épileptologie, vont peu à peu tarir l'expertise et l'intérêt des psychiatres hospitaliers au sujet de l'EEG et de l'épilepsie.

Jean-Claude DUPONT | Université de Picardie Jules Verne, France

L'épilepsie entre neurochimie et thérapeutique: une histoire croisée

La communication vise à démêler l'écheveau, complexe dans le cas de l'épilepsie, des relations historiques entre pathogénie neurochimique et thérapeutique. Dans les années cinquante, l'histoire de l'épilepsie croise celle de la neurotransmission. L'apparition des acides aminés dans le champ de la neurotransmission résulte dans une large mesure des spéculations reliant l'existence de neurotransmetteurs excitateurs et inhibiteurs à la pathogénie de l'épilepsie. Les recherches les plus poussées en ce domaine avaient été menées sur l'acide γ -

aminobutyrique (GABA), acide aminé qui n'entrait pas dans la composition des protéines, et que l'on avait démontré dès 1950 se trouver en plus forte concentration dans le tissu cérébral. Au Canada, la neurochimie (Kenneth Allan Caldwell Elliott) s'associa de façon spécialement étroite avec la neurophysiologie (Wilder Penfield, Herbert Jasper). Après que fut montré le rôle conjoint de l'acide glutamique et du GABA dans les crises épileptiques, le GABA devenait un excellent candidat pour un rôle de neurotransmetteur inhibiteur au niveau central, et l'acide glutamique comme neurotransmetteur excitateur. Ces travaux canadiens à la recherche des caractéristiques biochimiques du tissu épileptogène stimulèrent considérablement les recherches électrophysiologiques dans le monde concernant le GABA et les acides aminés. La démonstration expérimentale des transmissions spécifiques par ces acides aminés put ainsi être réalisée au niveau des synapses des crustacés par les auteurs japonais. Ici, l'histoire croise celle des antiépileptiques. Les convulsions épileptiques pouvant être liées à une augmentation de l'action excitatrice due à l'acide glutamique ou/et à un déficit en GABA, le traitement antiépileptique pouvait consister à restaurer la balance entre transmissions glutamatergiques excitatrices et GABAergiques inhibitrices pour diminuer l'excitabilité des neurones. Les barbituriques, très utilisés comme hypnotiques dans la première moitié du XXe siècle, tendaient alors à être abandonnés du fait de leur toxicité et de leur tolérance, au profit des benzodiazépines. On chercha à montrer que l'arsenal thérapeutique, devenu très large, cible certains récepteurs du glutamate et du GABA. L'interaction avec les phénomènes de neurotransmission sera en mesure d'expliquer le mode d'action de ces antiépileptiques et ceux-ci se révéleront de nouveaux outils de recherche éclairant la pathogénie de la maladie.

S018. Global Spencerism

Sat 27 July, 09:10–17:40 • Roscoe 2.5

Symposium organisers:

Bernard LIGHTMAN | York University, Canada
Daw-hwan WANG (non-participant) | Institute of History and Philology, Academia Sinica, Taiwan

Symposium abstract

In this symposium we are aiming to do for Herbert Spencer what has been done for Charles Darwin in various reception studies in the past. The topic fits nicely into the overall theme of the Congress, "Knowledge at Work," especially with its emphasis on communication and sites of knowing. The symposium will focus on how Spencerian ideas were disseminated and communicated around the globe, primarily in the second half of the nineteenth century and the early twentieth century. The participants will discuss both which ideas were disseminated in a particular region of the world and how they were communicated.

Especially after 2009, it is clear that the name most readily associated with evolutionary theory is Charles Darwin. Given Darwin's immense reputation it is easy to forget that Spencer, in his time, was almost as famous as Darwin. The theories of the two were often conflated. But Spencer's evolutionary theory, based as it was on Lamarckian modes of thought, was quite different from Darwin's. Since Darwin's theory of natural selection did not become fully accepted until the 1920's, Spencer's Lamarckian form of evolution still had scientific legitimacy into the early decades of the twentieth century. In the last few decades of the nineteenth century Spencer was read across the globe, from New York to Damascus, from Tokyo to Cape Town. Spencer was the first international public intellectual whose views on psychology, religion, sociology, ethics, education, and biology were listened to by a large and devoted audience. Spencer's attempt to synthesize all knowledge in a gigantic system of knowledge, based on evolution, captured the imagination of readers all over the world.

Although we know a great deal about the reception of Darwin in many countries around the world, and we know that the global sales of Spencer's book were significant, there have been few qualitative studies of how Spencer was received worldwide. The papers will cover the dissemination of Spencer's ideas in India, Russia, the Middle East, China, Japan, Mexico, Argentina, Brazil, the United States, Italy, Scandinavia, and France. Since we are attempting to construct a global history of Spencerism we have avoided an emphasis on western contexts.

S018-A

Sat 27 July, 09:10–10:40 • Roscoe 2.5

Chair: Nathalie RICHARD | Université du Maine, Le Mans, France

Michael GORDIN | Princeton University, United States

'What a go-ahead people they are!' Boris Chicherin and the hostile appropriation of Herbert Spencer in Imperial Russia

Every single one of Herbert Spencer's books were translated into Russian, often sooner than they entered any other language, and they were widely read by the late nineteenth-century intelligentsia across a wide range of fields — in fact, in just about every field which Spencer touched. Engagement with Spencer was, however, almost entirely negative; he was much discussed, and much rejected, and had no Russian "disciples" to speak of. After discussing the well-understood attack on Spencer's social theories by the radical Populists in the 1870s and 1880s, this paper turns to a discussion of the lifelong engagement with Spencer (and dogged rejection thereof) by prominent Russian historian, jurist, sometime mayor of Moscow, and liberal Boris N. Chicherin (1828-1904), spanning from social theory to biology to theology to positivist philosophy of science.

Marwa ELSHAKRY | Columbia University, United States

Spencer's Arabic audiences

Herbert Spencer had long-lasting appeal in the Arabic-reading world. One can find references to his work well into the mid twentieth-century. Even as late as the 1930s, when Talcott Parsons could ask 'Who now reads Spencer?', his works were being cited by Arabic leftists, Islamists and even feminists. In fact, Spencer was put to use by a surprising range of Arabic writers and intellectuals. This paper will consider what lay behind Spencer's broad appeal for Arabic readers, examining how he was read and whom he was read alongside, over the period from the 1890s to the late 1940s.

G. Clinton GODART | University of Southern California, United States

Herbert Spencer in Japan

I will present firstly an overview of the introductions and receptions of Herbert Spencer in Japan during the last decades of the nineteenth century, the "Spencer boom" in the 1880's, the Japanese government's consultation of Spencer on policy matters, and the usages of Spencer by both conservative government ideologues and the opposition in the Freedom and People's Rights Movement (Jiyūminkenundō). While many scholars have focused on these political uses of Herbert Spencer, I will highlight a second, but crucial and unexplored path of Spencer's influence in Japan: that of Buddhist philosophy. While at times critical of Spencer, reforming Buddhist philosophers in late-nineteenth century Japan embraced and disseminated Spencer's theories of evolution, and his ideas proved an important stimulus for religious thought. This, I will argue, adds an important global dimension to the assessment of Spencer's worldwide influence, and should broaden the parameters of the discussion on the relation between "religion" and evolution, a debate which is almost entirely dominated by the relations between evolution

and Christianity. Finally, I will discuss some possible reasons for the decline of Spencer's influence in Japan after the turn of the century.

S018-B

Sat 27 July, 11:10–12:40 ▪ Roscoe 2.5

Chair: Nathalie RICHARD | Université du Maine, Le Mans, France

General group discussion

Zunke KE | University of the Chinese Academy of Sciences, China

Bin Li | University of the Chinese Academy of Sciences, China

Herbert Spencer and science education in China

"What Knowledge is of Most Worth?" the first article on Spencer's Education was translated into Chinese by Yan Yongjing in 1882. During the end of the 1890s Spencer's thoughts on education were introduced to Chinese by Yen Fu, and then had a great impact on Chinese intellectual life and the development of modern education. Zen Hungchun, one of the leading figures of Chinese scientists cultivated in the United States, translated the first and second articles of Spencer's Education into Chinese in 1923, and promoted science education in China. Meanwhile, Spencer's Education was translated into Chinese by Hu yi, who studied education in the United States later and became a Chinese educationist. Hu yi's translation was republished first in 1962, and after being reedited by Wang Chengxu, another Chinese educationist trained in England, it was republished again and used mostly as reference in teacher education institutions, where Spencer's thoughts on science education were emphasized.

Mark FANCIS | University of Canterbury, New Zealand

Herbert Spencer in American social science and psychology

Herbert Spencer's huge impact upon American popular culture during the late nineteenth and early twentieth centuries has overshadowed the effect that he had upon the development of more specialized discourse. In particular, there has been too little analysis of the ways in which reactions to Spencer's ideas shaped the development of the social sciences and psychology. In the former Spencer was adopted enthusiastically – by ethnographers and early sociologists – as the source for evolutionary cultural theory. This was not a simple process as there were differing rationales at work: on the one hand, Spencer's avoidance of biological determinism when writing about social change was particularly appealing to ethnographers as early as John Wesley Powell and as late as Leslie White and Julian Steward; on the other hand, early sociologists, such as William Graham Sumner and Lester Ward, tended to read Spencer as a Darwinist so that he would appear to be a biological determinist.

Psychologists were less receptive to Spencer than their social science colleagues, and their attitude towards him chiefly depended on whether they felt able to read him as a materialistic philosopher who advocated Darwinian competition, or whether they rejected his work completely for not doing this. William James adopted the first strategy and laboriously re-configured Spencer's psychology so that it resembled social Darwinism. William MacDougall, with more scholarship and less humanity, took the second strategy and threw aside Spencer's ideas as useless for the construction of a psychology of racial determinism. John Dewey avoided both these strategies because he saw Spencer as a benign combination of science and liberal humanitarianism that would allow for the creation of a scientifically-based ethics. This sort of Spencerianism would avoid explaining human behaviour and development solely as a series of responses to competitive scenarios.

In both the social sciences and psychology, Spencer's writings became a reservoir for evolutionary ideas that were often opposed to each other. He could be seen as an exponent of a materialistic and competitive

Darwinism, he could function as a straw man whose arguments had to be rejected before evolutionary science could proceed, or he could be admired as a the liberal inheritor of the humanitarian science of the enlightenment. Spencerian language was contestable, but, nonetheless, it became a *lingua franca* for academic debate.

Commentary: Gregory RADICK | University of Leeds, United Kingdom

S018-C

Sat 27 July, 14:10–15:40 ▪ Roscoe 2.5

Chair: Bernard LIGHTMAN | York University, Canada

Bernard LIGHTMAN | York University, Canada

Spencer's American disciples

In this paper I will examine Spencer's most important disciples in the United States in the latter part of the nineteenth century, including the historian John Fiske, the journalist Edward Youmans, and the Protestant figures who were inspired by his religious thought. My goal is to see what attracted these thinkers to Spencer, and whether or not they were all attracted by the same aspects of his System of Synthetic Philosophy. Fiske was interested in Spencer's cosmic evolution and built an entire philosophy around it. Youmans, who worked for Appleton, was the driving force behind the International Scientific Series, and he intended it to be a vehicle for disseminating Spencer's ideas throughout the world. American Protestants found Spencer's Unknowable and his goal-directed evolutionary theory to be adaptable to Christian theology. I will also examine how Spencer's ideas were transmitted to the American public and how the means of transmission may have affected how he was understood.

Juan Manuel RODRIGUEZ-CASO | University of Leeds, United Kingdom

The ideology of the 'survival of the fittest' during the Porfiriato

The government of Porfirio Diaz or "Porfiriato" (1876-1911) was brought to a close by the Mexican Revolution. This was a period of profound social change in Mexican history. The country took huge strides forward in the areas of both infrastructure and communications under a government that, although democratically elected, had grown into a dictatorship with the passing years. This situation not only triggered the Mexican Revolution but had other consequences, notably in groups associated with education and culture.

These consequences included reforms at the National Preparatory School (*Escuela Nacional Preparatoria*), which, at that time, provided education based on Auguste Comte's logical positivism, a position that was not in favour with the government, being a philosophy that was considered morally suspect.

Despite government attacks, positivism remained a viable alternative, at least in the field of education. As an important aspect of its consolidation, we emphasize the role of Justo Sierra (1848-1912), a leading writer and politician. The positivist model was promoted by Sierra, but he departed from the Comtean tradition to embrace a clearly Spencerian vision. Sierra was one of the main promoters of the ideas underlying evolution in Mexico, emphasizing not only the influence of Spencer, but also Charles Darwin and John Stuart Mill. In that sense, it is clear that an interaction emerged between the concepts of social science and natural science to the point of consolidating social Darwinism in Mexico.

Based on an analysis of Sierra's original documents, and materials used to support the educational proposal for the National Preparatory School, we seek to demonstrate the decisive influence that Spencer's ideas had on strengthening the educational model, eventually influencing both national politics and relations with the Catholic Church, the main areas where Sierra's proposals were rejected.

This presentation is based on work co-authored by Rosaura Ruiz-Gutierrez and Ricardo Noguera-Solano.

Adriana NOVOA | University of South Florida, United States

The reception of Herbert Spencer's evolutionary ideas in Argentina, 1870-1910

The publication of *Origin of Species* in 1859 changed the way in which nature and man's place in it were regarded. In Argentina, more than anything, the new evolutionism challenged the perceptions of inherited romantic ideas about nature and politics. In a world of competition, struggle, and perpetual transformation it was difficult to accommodate the ideas of harmony and unity. The debate that followed only showed the confusion that existed in terms of how pre-Darwinian ideas could continue in the context of Darwinian science. More than anything, there was a philosophical gap that had to be filled since a theory based on the analysis of divergence over time disputed the hope that unity awaited in a certain future. The changes mentioned in the previous paragraph show us how the philosophical system that had served those who defended European ideas before 1859 started to be less coherent once that the true impact of the new science was understood, around 1870. In this essay, I will analyze how the synthetic philosophy of Herbert Spencer was used to correct what was perceived as the intrinsic materialism, and philosophical poverty, of Darwin's theory in order to allow the continuity of the ideology that was forming the ideology of the nation. The second part of the essay will explain the transition from Spencer's philosophy to the Monism of Ernst Haeckel. In it, I will show how synthetic thought was conceived, particularly regarding notions of aesthetics and race, and how the crisis of Spencerianism after 1890 triggered a revision of evolutionism that ended in the affirmation of a spiritual and romantic typology that will connect both Spencer's and Haeckel's ideas.

Heloisa Maria BERTOL DOMINGUES | Museu de Astronomia e Ciências Afins, Rio de Janeiro (MAST), Brazil

Spencerism against Darwinism in Brazil, 1870-1920

In this paper I will analyze the impact of Spencerism on Brazilian intellectual history at the end of the 19th Century and beginning of the 20th Century. The diffusion of Spencerism in Brazil, in the beginning of the 1870's was simultaneous to the diffusion of Darwin's theory. Nevertheless it did not have the same opposition suffered by Darwin. On the contrary, it was embraced by those who were looking for a theory for the Brazilian society, and had a great influence in the Brazilian intellectual scene. At that time, one of the most distinguished figures in the intellectual milieu, Silvio Romero, sought such theory through the analysis of the literary production of the country. Romero was a philosophy professor at D. Pedro II School, a journalist and a member founder of the Brazilian Academy of Letters. In 1888 he published the *History of the Brazilian Literature* in five volumes, where he affirmed, in the introduction, that he would interpret the Brazilian literature scientifically, or "à la Darwin", although he considered Spencer's theory the best one to base his interpretation. In this book, Romero failed to distinguish between the history of Brazilian literature and the history of Brazil, and recognized the fusion of the races as a characteristic of the evolutionary formation of Brazil. He observed, "The American races are a product of the American environment." In a country formed by different ethnicities, the debate among intellectuals revolved around the question: who was the real Brazilian? That was a racial question since the country, just issued from the condition of slavery, was faced with the image of three races. Spencerian intellectuals like him were polygenists, and thus, in the "struggle for existence" the victory would be of the "most adapted". Although presenting themselves as Darwinian intellectuals, as in the case of Silvio Romero, the polygenists professed Spencerian ideas that Darwin would have never accepted. According to the anthropologist Luiz de Castro Faria, Darwin would never be a Darwinian, still less a social Darwinian in Brazil. Silvio Romero, on the other hand, expressed for the evolutionism his position in relation to positivism, theory widely spread in

the country. In 1894, he published the book "Doctrines Against Doctrines – Evolutionism and Positivism in Brazil" where he opposed Evolutionism and Positivism, criticizing the last one that, for him, dominated the political ambience of the country. He affirmed that he was opposing Spencer to the dogmatic positivists, yet he opposed one form of positivism to the other, considering that Spencer was also a positivist. We find Spencer ideas not only in the historian milieu. In the 1930s, Spencer was an inspiration to Lourenço Filho, who was the author of a great Education project in Brazil, which aimed at a continued education for all, without punishments, secular, and introducing the science education in schools.

S018-D

Sat 27 July, 16:10–17:40 • Roscoe 2.5

Chair: Bernard LIGHTMAN | York University, Canada

Paola GOVONI | University of Bologna, Italy

The Spencer effect in liberal Italy, 1870s-1910s and beyond

When Herbert Spencer died (December 8, 1903), the British press proudly reported that Italian newspapers were also giving great prominence to the news, in one case even with mourning borders. On December 11, a member of the Italian Parliament, the jurist and university professor Agostino Berenini (1858–1939), delivered a speech on the English polymath warmly appreciated by the whole assembly: an honor by the way that Spencer would not have been happy about, since Bernini was a member of the Socialist Party. A few weeks later Spencer was celebrated by one of the few institutions whose membership he had granted the honor of accepting, the Accademia dei Lincei, the world's oldest science academy (1603). Soon afterwards, thanks to young philosopher Guglielmo Salvadori (1879-1953), the most active popularizer of Spencerism in Italy, the 1904 first issue of *Rivista di Filosofia e Scienze Affini* (Journal of Philosophy and Related Sciences) was entirely devoted to Spencer. The prompt reaction to Spencer's death was consistent with his reputation South of the Alps among scholars - humanists and scientists - of very different political persuasions, who nevertheless shared an interest in utilitarianism as well as an intolerance towards the power of the Catholic Church in Italian society. In this paper I shall first follow Salvadori's activities to show the different contexts in which Spencerism circulated in Italy. Secondly, I shall focus on Tullio Martello (1841-1918), a liberal and anti-socialist economist deeply interested in evolutionism. Concerning the lay public, at the beginning of the twentieth century several translations and reprints of Spencer's books and a survey of "The most widely read books by Italian People" (1906) confirmed the high circulation of Spencerism among "not expert readers". The 1906 sample shows that Spencer was appreciated, first, by "workers and shop keepers", and secondly by "white collars and professionals". While students declared little interest in Spencer, Catholic priests read his books carefully, "in order to refute his theories from the pulpit": this is the most reliable evidence I could find of Spencer's success among the restricted - as the paper will show - Italian public in the period 1870s-1910s c. In the following decades, Italian scholars occasionally felt the need to state that, after that early period of success, Spencer had been forgotten. However, a long period survey of the Italian publishing market shows that an interest in Spencer has been kept alive until recently and, again, by Italian scholars with outspoken, different political agendas.

Hans Henrik HJERMITSLEV | University College South Denmark, Denmark

Education and evolution: the reception of Herbert Spencer in Scandinavia, 1870-1920

Herbert Spencer's ideas were first introduced to a Scandinavian audience in the early 1870s when the Danish philosopher Harald Høffding published and lectured on his evolutionary philosophy. At this

time, Høffding also played an important role in disseminating Charles Darwin's theory of evolution and in discussing the philosophical consequences of an evolutionary worldview.

In the late 1870s and 1880s several of Spencer's works were translated into Danish and Swedish and he became a household name among liberal intellectuals who primarily discussed his views on education and evolution. His most influential and widespread work in Scandinavia was *Education* from 1861. It was translated into Danish in 1876, into Swedish in 1883 and into Norwegian in 1900. Parts of his works on sociology, ethics and philosophy were also translated into the Scandinavian languages, and a new generation of university professors of philosophy and sociology with positivist leanings embraced some of Spencer's ideas and applied them in cultural struggles against what they regarded as outdated romanticism, idealism and conservatism. At the other side of the debate, idealist philosophers regarded Spencer's evolutionary thinking as a problematic example of nihilistic materialism and naturalism.

The popularity of Spencer was not restricted to lecture theaters at universities. Two renowned freethinkers, the Danish literary critic Georg Brandes and the Norwegian poet Bjørnstjerne Bjørnson popularized Spencer's evolutionary and liberal ideas in their writings and in popular lectures. Also among some liberal Protestants within the national churches and at the folk high schools Spencer's ideas of freedom and progress were received with sympathy, albeit not uncritically, and through articles in widely circulated periodicals, Spencer was one of the best known foreign thinkers in the general public at the time of his death in 1903. Moreover, in the decades around 1900 Spencer's thoughts on education were part of the curricula at many colleges of education.

Spencer's ideas on evolution and education were thus widely circulated and positively received among liberal philosophers, sociologists, educationalists and authors in Scandinavia, while his influence on Scandinavian naturalists remained limited. Scandinavian naturalists preferred their colleague Charles Darwin's detailed empirical writings to the more philosophical perspective of Herbert Spencer. Likewise, Spencer's laissez-faire liberalism did not gain much popularity in Scandinavia among neither socialist nor conservative or liberal politicians who in the early decades of the twentieth century introduced some of the fundamental principles of the Scandinavian welfare states.

Nathalie RICHARD | Université du Maine, Le Mans, France

Un "moment spencérien" dans l'histoire culturelle française (1870-1890)?

En France entre 1870 et 1890 Spencer devint pour un temps le philosophe le plus publié et l'un des plus célèbres. Son œuvre fit l'objet de nombreux commentaires par des philosophes, des psychologues ou des théoriciens des sciences de la société. Mais elle eut aussi une influence sur des romanciers (Octave Mirbeau par exemple) et des artistes. Mon intervention traitera des divers aspects de cette réception et s'efforcera de mettre en lumière les raisons du succès de Spencer, les médiations qui assurèrent sa réputation, de même que les causes de son rapide déclin.

A 'Spencerian moment' in French cultural history? Spencer in France, 1870-1890

In France between 1870 and 1890, Herbert Spencer became the most prolific, and one of the most famous philosophers. His work was widely commented upon among philosophers, psychologists and social scientists. But it also influenced writers (such as Octave Mirbeau) and artists. My paper will deal with all aspects of this wide reception, describing the reasons of Spencer's success, the channels through which his reputation was established, as well as the cause of its rapid decline after 1890.

Commentary: Gowan DAWSON | University of Leicester, United Kingdom

S019. Aspects of the history of radio communications: how radio has transformed the world, and exploration, since the days of David Livingstone (1813-1873)

Sponsoring body:

Society for the History of Technology (SHOT)

Tue 23 July, 11:00–12:30 • Uni Place 4.206

Symposium organisers:

Michele FIORINI | IET Italy, Italy

Anne LOCKER (non-participant) | Institution of Engineering and Technology (IET), United Kingdom

Symposium abstract

2013 is the bicentenary of the birth of David Livingstone African missionary and explorer who famously lost communication with the outside world during his 1866-1873 expedition to find the source of the Nile, resulting in the 1871 expedition of Henry Stanley to search for him (Dr Livingstone I presume?). Our symposium aims to highlight how the application of the scientific theories and discoveries have led to developments in radio communications technology which have changed the world, and exploration, since Livingstone's day.

Chair: Robert MARTIN-ROYLE | Institution of Engineering and Technology, United Kingdom

Robert MARTIN-ROYLE | Institution of Engineering and Technology, United Kingdom

Aspects of the origins of radio communications

2013 is the bicentenary of the birth of David Livingstone, British missionary and explorer who famously lost communication with the outside world during his 1866-1873 African expedition to find the source of the Nile. This resulted in the 1871 expedition of Henry Stanley to search for him (and the phrase 'Dr Livingstone I presume?' on their meeting entered folklore). With the discovery of electromagnetic waves and developments in radio technology a modern day 'Livingstone' has access to a range of aids for navigation and communication to keep him in touch with the outside world.

This symposium, sponsored by the Institution of Engineering and Technology (IET), aims to highlight how the application of scientific theories and discoveries has led to developments in radio technology which have changed the world, and exploration, since Livingstone's day.

This introductory paper considers some aspects of the origins of radio communications.

Many scientists contributed to the emergence of radio communications but the paper read to the Royal Society in 1864 by James Clerk Maxwell, predicting electromagnetic (EM) waves, is seen as a fundamental landmark. But for the failure by the Royal Society, in 1880, to recognise the accidental discovery of EM waves by David Hughes some 7 to 8 years before Hertz, the story of radio may have been different. However it was the experiments by Hertz using electrical discharge sparks to generate EM waves which are today seen as the confirmation, in 1888, of Maxwell's predictions.

Interestingly Garrett, who has studied the private papers of Hertz, could find no evidence that Hertz saw any practical application of his discovery? Oliver Lodge, in his 1894 memorial lectures for Hertz, has been

credited by many as giving the first demonstration of the use of EM waves for wireless telegraphy. However this paper will consider the more recent arguments advanced by Sungook Hong that this is not so, and the true credit rightly goes to Marconi.

The use of a spark to generate EM waves, while adequate for telegraphy, was not well suited for voice transmission. Continuous waves (CW) were identified, by Fessenden among others, as necessary for that purpose. Practical cost effective means of generating and amplifying CW were not realised until the electronic era commenced in 1904 when Fleming in the UK invented the diode valve and, later, Lee de Forest in the USA inserted a grid creating the audion (triode).

Anna GUAGNINI | Università di Bologna, Italy

Full-scale experiments and knowledge formation in Marconi's wireless telegraphy stations

The paper explores the work carried out by Guglielmo Marconi and his assistants in the period culminating with the first transatlantic transmission in 1901. Their efforts focused on two main objectives: first, long distance communication, this being the trajectory chosen by Marconi for the development of the new technology he was pioneering; secondly, the design and construction of commercially reliable apparatus in order to attract much needed customers. It was a process that was to bear fruits in the 1910s, when the system became operative and orders began to flow in; in 1912 the rescue of the survivors of the Titanic disaster proved dramatically its value in emergency situations.

By the end of the century electromagnetic theory was a mature discipline, but it fell short of providing guidelines for the solution of the diverse problems encountered in the design of plants and apparatus for wireless telegraphy; at the same time, Marconi's head-start was being challenged by rival systems. Decisions could not be postponed awaiting theoretically sound guidance: relevant knowledge had to be developed on site.

The sites in this case were the numerous stations that were set up by the Wireless Telegraph and Signal Company (Marconi Wireless Telegraph Company from 1900) for demonstrations to potential customers; they were used as the stage for full-scale experiments in the course of which new apparatus and arrangements were tested and improvements were introduced. By 1898 two permanent stations were in operation at the Needles (Isle of Wight) and Bournemouth; two more stations on unprecedented size and complexity were established in 1899, in preparation for the transatlantic trial. These installations were described by Marconi as his laboratories: here he carried out research work with his team of engineers and advisors.

The aim of the paper is to examine the climate that permeated these establishments: it will analyse the criteria by which technical agendas were identified, the attitude towards problem-solving and the research practices that were implemented; the implications of full-scale experimenting will also be discussed. Finally, special attention will be paid to the tension that was engendered by the simultaneous pursuit of commercial and technological objectives.

Michele FIORINI | IET Italy, Italy

The distress call, from its Marconian maritime origins to hand-held devices

The just over centenary of Titanic's tragedy leads to a reflection on the safety of the maritime navigation and the role of wireless communication have played in the global shipping. The vessel, at that time, the largest and most luxurious ship ever built was equipped with one of the world's most advanced radios: a 5-kilowatt rotary spark transmitter that on a clear night could send signals from the middle of the Atlantic to New York City or London. The equipment was owned by Marconi's Wireless Telegraph Co. and operated by two of its employees, Jack Phillips and Harold Bride.

The first note to point out is that the technologies and the technicalities were ready but what lacked almost completely were international

protocols, standardizations and regulations. Shipboard operators were still an unregulated novelty, and they reported to their companies, not to the ship captain. They sent business and personal messages alike using assorted spark transmitters over various wavelengths. The vast majority of ships - at that time - had only one radio operator, who was obligated to serve only a 10-hour shift each day.

Titanic's loss was the subject of regulatory reviews covering a range of maritime practices, most notably the first International Convention for the Safety of Life at Sea (1914). One item of this wide-ranging legislation mandated that wireless reception on ships should be operated 24 hours a day for continuous monitoring of distress calls: this was the first time that the key importance that wireless could have in saving lives was recognised in laws that crossed international boundaries.

It should be remembered in mind that some important positive developments around communications technology in the last century giving rise to a need for ships to navigate safely and efficiently in all waters stem from the circumstances of the 'unsinkable' liner's fate.

The technical and procedural scenario of the distress calls on the night of 14 April 1912 and the efforts to regulate wireless at sea from governments and corporations (mainly Marconi's own company) will be presented as well as the progress made to date and the expected development from the basic wireless telegraphy to the modern eNavigation systems.

Des PROUSE | Institution of Engineering and Technology, United Kingdom

The birth of satellite communications

Science-fiction writers from the 1920s to the end of the 1950s dreamt of communicating via satellites (actually for the purpose of space-travel rather than to aid man's communication on Earth). A giant practical step forward occurred on 4th October 1957 when the Soviet Union successfully launched Sputnik - the very first man-made Earth-orbiting device (i.e. 'satellite'). Then on 10th July 1962, TELSTAR turned the sci-fi dreams into reality when this small (less than 1m diameter) satellite was successfully launched by the USA into Earth-orbit. This brought the very first full bandwidth live television pictures across the Atlantic and it simultaneously caught the imagination of audiences on both sides. It was also soon being also used for transatlantic telephone calls. This paper looks at the technologies and personalities that made satellite communications possible via the TELSTAR project from an historical perspective. What was driving these people forward? What was Project TELSTAR looking to achieve? Why wasn't it sufficient for transatlantic communications to rely upon the sub-sea cable technology that had developed so immensely over the previous 100 years? What lessons were learned from the project and how have they been applied since to ensure a highly successful evolution to the complex systems that exist today and which form such a fundamental part of the fabric of society? These are some of the questions that will be addressed in tracing the technical evolution of satellite communication systems, illustrating throughout what a marvellous source of inspiration TELSTAR has been and will continue to be for future generations. In keeping with the theme of highlighting how the application of scientific theories & discoveries have led to technological developments which have changed the world, and exploration, since Livingstone's day, the paper summarises the principles of global positioning satellites (GPS) and satellite ('hand-held' telephones and also touches on the role of satellites in emergency and disaster-management situations. If these technologies had been available in Livingstone's day, his friend Henry Stanley could have stayed at home and waited for the call!!

S020. Plant science and global food security in the twentieth century

Tue 23 July, 09:00–12:30 ▪ Uni Place 4.204

Symposium organisers:

Jonathan HARWOOD | University of Manchester, United Kingdom

Harro MAAT | Wageningen University, Netherlands

Symposium abstract

Plant science is fundamental to the global food economy of the twentieth century. Knowledge about the ecology of crops, plant species or the physiology and DNA of individual plants have all affected the amount and quality of food produced all over the world. A key role is played by plant breeding and genetics. Increasingly, throughout the twentieth century, genetic composition was considered the blueprint for a plant's characteristics. This opened the door for a 'design perspective' on biology and agriculture. Desired features - whether high yield, disease resistance or taste - could be introduced by changing the plant's genetic composition. As a result, the production and characteristics of food crops - most prominently wheat, rice and maize - have changed significantly.

Studies in the history and sociology of biology and agricultural science have made clear that the contribution of science to food production, in individual countries and on the international level, was neither a straightforward application of existing knowledge nor an uncontested activity. Likewise, studies in the history of agriculture as well as economic and social-political analyses of agrarian production have shown that the impact of science-based plant improvement was uneven across countries and regions, with differential effects upon farmers, traders and consumers. While this picture holds true for most places in general terms, more detailed accounts of the role of plant science in food security are hardly available for certain countries, institutional settings or historical periods. This session aims, therefore, to fill in some of these gaps but also to provide insight into new and as yet unexplored terrain in this area.

The papers in these sessions should provide a good overview of the various issues under study and the diversity of approaches being used, as well as covering a range of geographical and cultural settings across the twentieth century.

S020-A

Tue 23 July, 09:00–10:30 ▪ Uni Place 4.204

Chair: Jonathan HARWOOD | University of Manchester, United Kingdom

Tae-Ho KIM | Seoul National University Hospital, Korea, Republic of

Atomic radiation versus human hands: the Cold War and rice breeding in South Korea in the 1960-70s

This article illuminates how international politics in the Cold War era influenced the rice breeding program in South Korea in the 1960-70s. The "Green Revolution" in South Korea in the 1970s was the outcome of amalgamation of two different traditions in agricultural science: Japanese colonial legacy and postwar American influence. From the early twentieth century, Japanese agricultural institutions in Korean Peninsula replaced indigenous cultivars and cultivation techniques with Japanese ones based on modern agricultural science. The hegemony of Japanese agronomy in Korea remained undiminished up to the late 1960s, primarily because Japan was the only center of scientific research on "Japonica" rice varieties. Meanwhile, as South Korea had gradually been incorporated into American hegemony since its independence in 1945, American agronomy began to exert influence to South Korea. In the late 1950s, in particular, the "Atoms for Peace" project significantly affected agricultural science, with the promise of mutation breeding program. The boom of mutation breeding did not last long in Korea, but American

influence gained a new momentum in the 1960s with the initiation of the Green Revolution in rice, which was based on the classical way of cross-breeding. In the mid-1960s, South Korean agronomists visited the International Rice Research Institute (IRRI) in the Philippines and succeeded in hybridization of IRRI's Indica rice with Japonica varieties. The new hybrid rice, Tongil [reunification], was highly productive and disease-resistant, and soon endorsed by South Korean government as the spearhead of the Green Revolution. With massive mobilization in rural communities, Tongil contributed in doubling domestic rice production in the 1970s. Tongil rice disappeared in the early 1980s, after its poor crops were coincided with the collapse of the authoritarian Park Chung Hee regime in 1979. However, Tongil is still remembered by South Korean agronomists as the most important achievement in the history of South Korean agronomy, especially in that they took advantage of the American Cold War strategy to deviate from the Japanese colonial legacy.

Jacob HAMBLIN | Oregon State University, United States

The death and rebirth of atomic agriculture at the International Atomic Energy Agency

Despite initially high expectations, studies on the agricultural uses of atomic radiation began to lose funding in the early 1960s. This broad category of research included grain irradiation, mutation plant breeding, fertilizer studies, food sterilization, and insect control. In both the United States and United Kingdom, meager or uneven results led to massive cuts in expenditures in just a few years. Rather than allow the enterprise to die, scientists such as Henry Seligman (of the UK's Wantage Laboratory) and Maurice Fried (of the US Department of Agriculture) migrated to the International Atomic Energy Agency. There they found willing patrons for work at the Seibersdorf Laboratory, and colleagues who had experienced the same phenomenon at home. IAEA officials tried to reverse the trends at home institutions, even inventing a system of faux sponsorship (in name but not involving real money), to give scientists the appearance of international endorsement, to assist in their struggles for funding at home. This paper explores the consequences of the IAEA's attempt to resuscitate the legitimacy of knowledge about agricultural uses of atomic energy, by circulating experts within the UN system. One of these was the creation of an embattled coterie of experts who used every tool at their disposal to justify their research, creating conflict with other agencies such as the World Health Organization and the Food and Agriculture Organization. Another was the fast-paced dissemination of research programs in the developing world, at the same time these were being curtailed in the industrialized world. This paper is drawn from archival research in the archives of the IAEA, FAO, WHO, the US and UK national archives.

Harro MAAT | Wageningen University, Netherlands

Upland versus lowland rice in the twentieth century

Upland rice indicates low-tillage cultivation of a paddy on fields that are well-drained. Upland (or dryland) rice is commonly characterised as having less yield potential and, therefore, little to offer for improvement of farmers' livelihoods or national food security. D.H. Grist, author of a major handbook of rice, comments that "[d]ryland paddy cultivation continues to be neglected(...) and is frowned upon by governments because of soil erosion danger resulting from shifting cultivation with which dryland paddy has been closely associated."(1975: 195). This paper explores this negative association and places its origin in a colonial context. The Dutch efforts to improve rice cultivation in Indonesia provide evidence for the argument that land degradation was less a concern than commercial interest from the plantation sector. Upland rice, unlike lowland wet paddy fields, were considered not to contribute to the production for global markets. The negative ecological image of upland rice was a consequence rather than cause of the lack of attention upland rice received from governments and research institutes.

S020-B

Tue 23 July, 11:00–12:30 ▪ Uni Place 4.204

Chair: Harro MAAT | Wageningen University, Netherlands

Dominic GLOVER | Wageningen University, Netherlands

Tracing the roots of the ‘root revolution’: exploring the origins of the system of rice intensification

The System of Rice Intensification (SRI) is a method of rice cultivation whose origins are the subject of an interesting creation mythology. SRI has been termed a ‘root revolution’ on the grounds that for the first time it directs the attention of scientists and farmers to the creation of conditions for vigorous and healthy root growth.

According to orthodox accounts, SRI was discovered or invented in Madagascar quite suddenly in the early 1980s, by a French Jesuit missionary who was also a trained agronomist and rural development worker. The priest, the late Father Henri de Laulanié, described SRI as a method ‘founded on the physiology of rice’, ascribing his inspiration to his close observation of rice itself. However, such breakthroughs are also built on prior insights and previous discoveries, and indeed de Laulanié drew on various sources to build his knowledge of rice physiology and paddy cultivation methods.

An investigation of those sources as well as other historical precedents for SRI shows that the principles and practices of SRI are not as unique, novel or original as its creation myth suggests. The direct lineage of the SRI methodology as well as various analogues from different times and places reveal various connections with colonial agricultural science as well as farmers’ practices in different times and places.

SRI’s creation myth serves to mobilise networks of activists and scientists by positioning SRI as a grassroots alternative to conventional, styles of agricultural research and methods of rice cultivation associated with the Green Revolution. However, this act of storytelling does not by itself invalidate the physiological theory underlying SRI or the technical principles of SRI cultivation methods. If anything, the rediscovery or re-emergence of SRI-type methods makes the system even more intriguing than if it were genuinely unprecedented. How and why did these principles come to be overlooked or forgotten? Where did they go? Why have they reappeared?

SRI methods have been controversial in scientific circles. Digging down to its roots serves not to uproot the system but show how deeply anchored it is in historical precedents, including scientific research and established farmers’ practice. Both SRI’s proponents and its critics could do better at learning lessons from previous experiments and experiences with SRI-like cultivation methods.

Commentary: Jonathan HARWOOD | University of Manchester, United Kingdom

General group discussion

S021. Industrial heritage and history of technology in the Luso-Brazilian world

Wed 24 July, 14:10–17:40 ▪ Uni Place 4.212

Symposium organisers:

José Manuel LOPES CORDEIRO | Universidade do Minho, Portugal

Cristina MENEGUELLO | Universidade Estadual de Campinas, Brazil

Symposium abstract

This Symposium proposes an approach to the technology and industrial heritage of the Luso-Brazilian world. Therefore, it intends at construing the theme of archaeology and history of technology and industrial knowledge ranging from the XVI to the XXI centuries, taking into consideration the common roots of Brazil and Portugal. In this sense, it will be possible to investigate the exchange and adaptation of technologies and, on the other hand, the material and immaterial results of these processes in the industrial heritage, including techniques and objects in the workplace as well as the professional and non-professional knowledge of engineers, artisans and workforce.

The overseas expansion of Portugal, which began with the capture of the North African town of Ceuta in 1415, was followed by the exploration encouraged by Infante Henrique (Prince Henry the Navigator) - including the West Coast of Africa, the voyage to India by Vasco da Gama and the discovery of Brazil in 1500. Such a massive colonial empire, maintained longer than most other European colonizing countries resulted that, from South America to Africa to Asia, people who had no native cultures nor origins share a common language, heritage and common cultural traits. This Symposium is particularly interested in investigating the exchange and transformation of technology along the centuries and the resulting knowledge that can be considered, in the 21st century, a common heritage. This common heritage encompasses the study of the material culture, with a focus on industry and work, recording and understanding the remains of industrialization, including the technology, transport and buildings associated with manufacture or raw material production. Such work encompasses economics and the social history, traditional archaeology, material and immaterial heritage, architecture and engineering and history of technologies and of techniques, always in a context of exchange, adaptation and innovation.

S021-A

Wed 24 July, 14:10–15:40 ▪ Uni Place 4.212

Chair: Cristina MENEGUELLO | Universidade Estadual de Campinas, Brazil

José Manuel LOPES CORDEIRO | Universidade do Minho, Portugal

The prohibition of manufactures in Brazil (1785): a new vision

Through the law (alvará) of January 5, 1785, promulgated by the Queen of Portugal D. Maria I, textile manufactures were banned in Brazil and all those that existed were closed. Recent research has highlighted that, despite that prohibition, cottage textile industry was far more widespread in colonial Brazil than previously thought. This paper will present some cases that illustrate the existence of textile units in colonial Brazil, despite the royal prohibition.

Cristina MENEGUELLO | Universidade Estadual de Campinas, Brazil

Industrial heritage in Brazil: a difficult memory

Ruins in the contemporary urban fabric can be considered to be a ‘difficult memory’, as Paul Ricœur named it in *Memory, History, Forgetting*. They are hard to recall and difficult to grasp and to confer new meanings and significances for the present uses. Different from the classical cult to ruins that spread from the first excavations in the XVI century to the Romantic XIX century ruins visited in the Grand Tours, our contemporary ruins are produced by the fall of the industrial civilization and considered to be hindrances to the urban development. Nowadays, in a country of relative recent urbanization such as Brazil, the vestiges of industrial plants, mills, railways and warehouses constitute a new urban language that, between requalification, heritage and destruction, bring new challenges for urban planning. When preserving only a small parcel

of large industrial complexes, in order to allude to some piece of memory - chimneys standing for factories - the space dimension is overlooked: these samples preserved act mostly as symbolic remains, preventing new generations from understanding the industrial activity in itself. On the other hand, requalifications generally edulcorate the industrial activity, transforming spaces meant for work in 'cultural' or 'leisure' sites. Few and innocuous preservation initiatives based only on tourism imperatives, the destruction of factories built in modern architecture style, not yet considered endangered or 'old enough' to be preserved and a general lack of public consciousness and of clear state policies all thrive in a country facing major problems concerning poverty, mass migration and urban violence. What is the reality of industrial heritage preservation today in Brazil? My aim is to present and debate recent cases of industrial heritage in Brazil (specifically in the state of São Paulo), with the aid of a photo essay - in order to analyze the difficult relationship between suppression and interest, conservation and reconceptualization based on concrete examples of contemporary urban Brazil.

Eduardo ROMERO DE OLIVEIRA | São Paulo State University, Brazil

Espaços de trabalho e produção ferroviária: estudos sobre termos técnicos ferroviários (São Paulo, 1868-1930)

O propósito deste trabalho é apresentar resultados de investigações históricas sobre 3 oficinas ferroviárias existentes no estado de São Paulo: Oficinas de Jundiaí e Oficinas de Rio Claro, pertencentes à Companhia Paulista de Estradas de Ferro; e Oficinas de Campinas, da Companhia Mogiana. O propósito do estudo foi conhecer a tecnologia de fabricação e manutenção, assim como da engenharia ferroviária, a partir do estudo da terminologia ferroviária identificada em documentos produzidos ou utilizados pela empresas férreas. Com vistas a aprofundar investigações históricas sobre as oficinas ferroviárias, realizamos o estudo sobre a terminologia ferroviária com base em catalogações de materiais ferroviários, manuais de engenharia ferroviária e em um corpus de documentos específicos (os relatórios das empresas ferroviárias) de um período em que ocorreu a maior expansão das empresas ferroviárias em São Paulo (1868 a 1930). O corpus está formado pelos seguintes documentos: Relatórios da Companhia Mogiana de Estrada de Ferro (1873-1930); Relatórios da Companhia Paulista de Estradas de Ferro e Vias Fluviais (1869-1971). Há séries desses relatórios depositados nos acervos do Arquivo Público do Estado (São Paulo), do Museu da Companhia Paulista (Jundiaí). Isso envolveu procedimentos de pesquisa histórica e arquivística. Para identificar os termos contidos nos documentos, usamos o programa de análise lexical WordSmith Tools. Todas as informações coletadas sobre os termos (classificação, contexto, definição, frequência, relatório, notas de uso, data) foram organizadas em fichas terminológicas. Do ponto de vista da pesquisa documental histórica-arquivística, nós identificamos descritores nas antigas catalogações de conjuntos bibliográficos ou documentais (nos acervos originários das empresas ou instituições de ensino). Do ponto de vista da pesquisa histórica, nós procuramos identificar termos técnicos em manuais de engenharia ferroviária e relatórios, o que nos permitiu reconhecer alguns usos e funções do espaço de produção, conhecimentos técnicos e trabalho ferroviário. Esta apresentação traz resultados de pesquisa financiada pela FAPESP.

Rail workspaces and production: historical studies of railway technical terms in Sao Paulo, 1868-1930

The purpose of this work is to present results of historical research on three railway workshops in the state of Sao Paulo: Workshops of Jundiaí and Workshops of Rio Claro, owned by Companhia Paulista Railway, and Workshops of Campinas, owned by Company Mogiana. The purpose was to study the technology of manufacturing and maintenance, as well as railway engineering, from the study of railway terminology identified in documents produced or used by

railway companies. In order to further historical research on the railway workshops, we conducted a study on railway terminology based on railway material cataloging, railway engineering manuals and a corpus of documents (railway companies reports) specific to a period in which there was the fastest companies growing in Sao Paulo (1868-1930). The corpus is comprised of the following documents: Reports of Companhia Mogiana de Estrada de Ferro (1873-1930); Reports of Companhia Paulista de Estradas de Ferro e Vias Fluviais (1869-1971). There are series of reports deposited in the collections of the Public Archives of the State (Sao Paulo) of the Companhia Paulista Museum (Jundiaí). This involved procedures of historical research and archival. The lexical analysis software WordSmith Tools was used to identify the terms contained in the documents. All data collected (term classification, context, definition, frequency, report, usage notes, date) were organized in terminological records. From the standpoint of historical-archival documentary research, we identified descriptors in the old cataloging of bibliographic and documentary collections (the collections of the originating companies or educational institutions). From the standpoint of historical research, we seek to identify technical terms in railway engineering manuals and reports, which allowed us to recognize some of the uses and functions of production space, technical knowledge and rail work. This paper presents results of a research project funded by FAPESP.

This presentation is based on work co-authored by Ivanir Azevedo Delvizio.

Marcelo DE PAIVA | FAU-USP, Brazil

Manufacturing the city: São Bernardo do Campo and the industrial heritage

This paper aims to evaluate the role played by industry, work and social movements in São Bernardo do Campo's official cultural heritage preservation. It consists on part of an ongoing master's research in FAU-USP (Architecture and Urbanism School in Universidade São Paulo, Brasil) which aims to analyze municipal public policies for cultural heritage preservation as a social process started by specific agents within institutionalized agencies related to the State. As a case study it takes the Municipal Council for Historic and Cultural Heritage of São Bernardo do Campo - COMPAHC-SBC. Located midway between Port of Santos and the city of São Paulo, Brasil, the strategic position of the city has encouraged a huge industrialization process during the entire 20th century. Its climax has come in the 50's when President Juscelino Kubitschek issued the "Plano de Metas" (Plan of Goals) which made São Bernardo the main stage of consumer goods industry, specially carmakers. From the 70's to the 80's, the huge mass of workers who moved to São Bernardo in search of jobs formed strong labour unions and started a significant social movement which most important expression is the Brazilian Laborers Party (Partido dos Trabalhadores). This paper aims to evaluate the role played (or not) by the memories of industry, work and workers in the city's cultural heritage preservation policies. To do so, the selection process of buildings listed by COMPAHC-SBC as well as the council's registers related to work and industry will be put under perspective. More than that will also be put in perspective the agents involved in cultural heritage preservation as well as the instruments used to preserve those buildings such as listing or inventorying. This multi angled approach is put into practice to make it possible to evaluate how and why industrial heritage is or is not preserved in São Bernardo do Campo. The case of São Bernardo do Campo will also be situated in the wider discussion of preservation policies in Brasil specially those related to industrial heritage. This way, federal and state policies and practices will be taken into account as well as the development of industrial heritage as a preservation typology in the country. On the other hand, other preservation initiatives in post

industrial cities all over the world will be taken in comparison in order to deepen and better situate the analysis on the industrial heritage of São Bernardo do Campo.

S021-B

Wed 24 July, 16:10–17:40 ▪ Uni Place 4.212

Chair: José Manuel LOPES CORDEIRO | Universidade do Minho, Portugal

Luiz Carlos SOARES | PPGH/UFF and HCTE/UFRJ, Brazil

Industrial activities in a slave society: a case study of the textile mills in the *fluminense* region, 1840-1880

From the 1840's onwards, several textile mills (for cotton spinning and weaving) were created in Rio de Janeiro County and in the outskirts of some adjacent cities of the Brazilian capital. It was, in fact, the beginning of an industrial growth not only in the textile industries, but also in several branches of industrial activity, which were stimulated by the general growth of slave coffee plantation economy, the population increase in the capital and in provinces of Southeastern Brazil (which also implied in the expansion of the internal market) and the adoption of several measures for industrial stimulus by the Imperial government. These textile mills were established in the *fluminense* region by foreign merchants (who usually operated in the import-export trade) as a strategy to diversify their capital in a more favorable conjuncture for industrial investments of great magnitude, employing free and salaried workers.

Consequently, the objective of this paper is related to the study of the dimension and nature of the textile mills established in the *fluminense* region, which means the attempt to understand their characteristics as a specific type of industrial establishment and its technical and productive organization. An element which immediately attracts our attention is the localization of these textile mills outside of the urban areas due to their necessity to make good use of natural water falls or those artificially created from the waters of a voluminous river. Evidently, the water power created motion for the operation of spinning and weaving machines and this hydraulic mechanism was the most relevant technological attribute of the *fluminense* textile mills until the early 1880's, when steam power was introduced in this and other industrial branches.

The *fluminense* textile mills did not have the condition to become a germination pole of a new industrial technology to other branches of transformation activities, as happened in England in the very beginning of the nineteenth century. Also, the utilization of hydraulic machines indicated the limits of industrial activity in a social context in which export agriculture and slave labour still predominated. Nevertheless, the accentuated decline of slavery and slave society in Brazil, in the 1880's, would allow the emergence of new possibilities of development for textile mills and other industrial branches with the introduction of steam engines and the exponential growth of industrial production.

Gildo MAGALHÃES SANTOS | Universidade de São Paulo, Brazil

A milestone in the Atlantic rainforest: the Itatinga dam and its power station

At the end of 19th Century the growing exportation of sugar and coffee in the southern state of São Paulo, Brazil, led to the expansion and modernization of the ancient harbor of Santos. Electrical equipment prevailed as the choice for larger capacity hoisting equipment in charge of cargo to be picked up from the incoming railway Jundiaí-Santos and loading it onto the ships. Soon after the new Republic was inaugurated, a concession (1891) was given to build a dam 700 m above the sea level, taking advantage of the turbulent waters of Itapanhaú River, running in the tropical woods covering Serra do Mar, a mountain range

separating the seaside from the interior lands. The stream was channeled through a 3-km stone tunnel, flowing into the dam and downhill through pipes to power the turbines of Itatinga substation, not far away from the sea docks.

Construction had to be interrupted several times because of difficult sanitary conditions that plagued swampy coastal areas as Itatinga and Santos, including yellow fever and malaria. Finally the service began to operate in 1910, and the private company that owns the power station has been able, due to the excess energy produced, to supply or complement electricity for neighboring cities, even nowadays. This service was however, during many decades, subject to constant economic and political struggles with the monopolistic British-Canadian Light and Power Co., which held the concession for the nearby city of São Paulo and surroundings.

This power station had a deep impact in the social, cultural and economic history of the region, since the surplus generated by coffee exports were instrumental in the industrialization of São Paulo, at an ever increasing pace since the 1910's. It is a living part of the national electrical heritage, which is not well-known and remains to be better utilized. The processes of designing, building, operating and maintaining this enterprise, as well as the machines, architectural and engineering features, and the role of the technicians and workforce involved there await to be highlighted in the future.

Marcus GRANATO | Museum of Astronomy and Related Sciences, Brazil

Scientific heritage in Brazil: surveying results of sets and collections of artefacts, related to the exact sciences and engineering

Most of Brazil's science and technology heritage has yet to be tracked down. The knowledge amassed on the topic is still limited, and there is a real risk that Brazilian science and technology objects may already have been modernized or discarded, mostly to make way for more recent or up-to-date instruments or apparatus. A national survey was begun in 2010 to build up a picture of the current state of this heritage as a first step towards changing this picture. The survey is divided into different areas of knowledge and different time frames. As such, we are interested in sets of objects from the exact sciences, the different engineering specialties, as well as geography, geology and oceanography, which were manufactured in or before the 1960s. We assume that objects produced after this decade may still be in use and therefore fall outside the scope of the project.

This work presents an overview of Brazil's scientific heritage and the information provided is the outcome of this survey which is being undertaken under the coordination of Museu de Astronomia e Ciências Afins ("Museum of Astronomy and Related Sciences", or MAST), which is leading teams from five Brazilian universities.

A registration form was prepared which was adapted from a form used in surveys of collections of this kind in Portugal. Sets of objects have been identified at museums, universities, military establishments and some secondary schools. The best preserved collections are at the few museums devoted to the area, but the universities hold most of the artifacts. The overwhelming majority of the objects were made in the twentieth century, primarily the second half. The objective of this initiative is to raise the awareness of the Brazilian state so that a policy is created for preserving this heritage and financing mechanisms to assure it can be researched, conserved and ultimately fulfill its mission in society.

This presentation is based on work co-authored by Ethel Handfas and Fernanda P Santos.

S022. From natural history to ecology: towards a comparative history of life sciences in the long nineteenth century

Wed 24 July, 09:00–15:30 ▪ Uni Place 4.204

Symposium organisers:

Eduard KOLCHINSKY | Institute for the History of Science and Technology, Russian Academy of Sciences, St.Petersburg, Russia

Staffan MUELLER-WILLE | University of Exeter, United Kingdom

Symposium abstract

Until recently, the historiography of life sciences in the long 19th century has tended to privilege the history of evolutionary theory, while neglecting other important research agendas. At the same time its narrative framework has been traditionally structured along disciplinary divisions as they emerged within the university system, implicitly privileging fundamental over applied research. The symposium will attempt to redress the balance by examining reciprocal relations between academic research - from natural history and natural philosophy to early 20th century biology- on the one hand, and pragmatic concerns of states and societies managing their natural resources on the other. More specifically, the symposium will focus on a gradual 'scientization' of nature management with a parallel emergence of ecology as a distinctive area of research by the end of the period. While in the last two decades the history of ecology has attracted considerable scholarly attention, the account still remains rather patchy: it concentrates on the countries of North-Western Europe and North America, or the colonies of European oceanic empires. The symposium seeks to contribute to a wider cross-national comparative study of early ecological research by examining the emergence of proto-ecological and early ecological theories and concepts in different national contexts. In particular we will seek to address the following issues:

- Relationships between the life sciences and various agencies directly engaged in nature management (governmental boards for agriculture, forestry, fisheries, local authorities, industrialists' and landowners' associations, cooperatives etc.) and the role of these agencies in shaping institutional infrastructures for research and its agenda;
- The changing nature of expertise in nature management, the rise of university-trained scientists as experts in this area, as well as public controversies concerning nature management and the role of scientists in their resolution;
- Changing boundaries between 'fundamental' and 'applied' research, between 'amateur naturalists' and 'professional scientists' and the role of non-university institutional environments in the advancement of proto-ecological and early ecological ideas;
- The role of material infrastructures of research (availability of high-quality laboratory equipment, accessibility of literature, museum collections) in promoting or discouraging particular research agendas;
- Distinctive national styles in early ecological theories and how they were impacted by the circulation of people and concepts across national boundaries.

Wed 24 July, 09:00–10:30 ▪ Uni Place 4.204

Chair: Denis SHAW | University of Birmingham, United Kingdom

Brigitte HOPPE | Ludwig-Maximilians-University of Munich, Germany

Early ecological observations: theoretical basis and empiricism in natural history

Asking for ecological knowledge at work, we find many qualitative ecological statements, mainly relating to the area of autecology or species and population ecology, belonging to higher plants and animals long before the creation of the special field in the 19th century. This paper will call attention to the early observations of ecological phenomena since the 16th century. It states that observations on climatic factors, air temperature, the quality of surroundings and of the soil, on the time of florescence and fructification etc. did not arrive incidentally, but were based on the fundamentals of empirical sciences. The empirical research was performed in combination with theoretical presuppositions being characteristic of the 16th and 17th century natural history. Examples of two important empirical fields of this time will be evaluated: Some results of European overseas travellers and their explorations in very different regions of the world, the attempts to transfer living animals over long distances and to cultivate plants in botanic gardens will be discussed. By analyzing the reports of travelling naturalists describing their observations made in foreign countries, documenting the new kind of field research including elementary experimental methods, we find out that authors, trained earlier in scientific fields, based their observations and descriptions on the principles of the traditional European science. The Aristotelian categories *locus* and *tempus*, renewed under others by methodologies and used as rules of conduct by the authors of European Renaissance herbals and zoological books during the Pre-Linnaean period, led the naturalists to observe the living space and the life periods of living objects. Thus, that means in sum, they paid attention to ecological living conditions.

Eduard KOLCHINSKY | Institute for the History of Science and Technology, Russian Academy of Sciences, St.Petersburg, Russia

Exploratory voyages in the Russian empire and their role in the formation of animal ecology

The paper aims at demonstrating how exploratory voyages in the Russian empire formed the basis for accumulating data on the relations between animals and their environment, their behaviour in animal communities, and how this process led to the making of a new discipline. Those naturalists who took part in the 2nd Kamchatka expedition (1733-1743) and the expeditions organised by the St. Petersburg Academy of Sciences in 1768-1774 carried out their research within the framework of natural history, however their travel journals and treatises contain some data that can be retrospectively considered as proto-ecological. From this perspective it is particularly interesting to examine Peter Pallas's studies on rodents and the work done by G. Steller (1751) who for the first time in Russia provided a complex description of animals' natural habitats and who suggested that animals' traits and behaviour could have an adaptive value. The territory of Russia provided scholars and travellers with a unique opportunity to study animal species in different geographic zones and eco-systems, to analyse their migrations and their population dynamics, their adaptability to abiotic factors, the specificities of their biological niches and the impact exercised by these niches on nutrition, geographic and seasonal variability, distribution areas etc.

In the studies produced in the 1830s-1850s by E.A. Eversmann, K. E. Von Baer, A.F. Middendorf, N.A. Severtsov, the issues of proto-ecology and animal geography were still merged with other problem fields of biology. In this period a great role was played by exploratory voyages organised by Russian state administration, universities, learned societies

and local authorities who were interested in environmental data for pragmatic reasons – it was hoped that these data could be useful for devising the means of protection against pests, parasites, disease carriers, or for rationalization of fisheries or hunt. All these issues required increasing attention to the study of animal life cycles and their distribution areas.

In the 1860s-1890s the basis was laid for the making of applied ichthyology (N.Ya. Danilevsky, K.F. Kessler, O.A. von Grimm), ecology of pest insects (F.P. Koeppen), ecology of parasites (I.I. Mechnikov, A.P. Fedchenko), ecology of game and forest animals (A.A. Silant'ev), etc. New methods of estimating population size were developed. The formation of animal ecology was made possible by progressive differentiation of various branches of zoology.

Staffan MUELLER-WILLE | University of Exeter, United Kingdom

Botanical arithmetic: cataloguing and quantifying living nature around 1800

Alexander von Humboldt's *De distributione geographica plantarum* (1817) is rightly considered a milestone in the quantitative treatment of taxonomy and biogeography. In this paper, I aim to uncover the contextual and infrastructural conditions that enabled Humboldt to endorse this new approach. For this, I will focus on the work of Karl Ludwig Willdenow, who was Humboldt's botanical mentor in the 1780s, and Karl Sigismund Kunth, a merchant's clerk who served as Humboldt's personal assistant in Paris from 1813 to 1820. Both Willdenow and Kunth were immersed in cameralist projects of exploring domestic and exotic resources for the promotion of Prussia's economy, and both had particular skills in designing paper technologies to record and process information on plants and animals. These technologies allowed for a form of observation that was at once detailed and bound by strict, Linnaean convention, a combination that inadvertently suggested new objects of research. The new perspective on "dynamic relationships among organisms, and between organisms and their environment" that characterizes nineteenth-century biology (Nyhart) can thus be seen as directly related, rather than opposed to, the Linnaean tradition.

S022-B

Wed 24 July, 11:00–12:30 ▪ Uni Place 4.204

Chair: Staffan MUELLER-WILLE | University of Exeter, United Kingdom

Nils GÜTTLER | University of Erfurt, Germany

Mapping Heimat: the observation and conservation of regional environments in Germany by 1900

The geographical distribution of organisms and their assembly in habitats were central problems for early scientific ecology at the turn of the 20th century. However, it was difficult to study these phenomena without collecting an enormous amount of local data. A particular group within the scientific community thus became essential for the observation-laden ecological research: lay observers. In the second half of the 19th century, skilled amateurs who were organized in local societies of national history accumulated large quantities of data on the nature and culture of regional environments across Europe. The practice of mapping became a particularly popular method through which to link the network of observers with its objects. In Germany these surveys on regional environments involved a claim for a conservation of landscapes, and were thereby influenced by a specific concept of regionality: "Heimat" (roughly translated as "homeland"). My paper will focus on the concept and practice of "Heimat" in ecological data-gathering in Germany by 1900. As I will show, "Heimat" became a link between academic and amateur science while simultaneously impacting the emerging discipline of ecology on both conceptual and material levels.

My paper focuses on the mapping activities of Dresden's society of natural history Isis as well as on private exchange organizations for natural specimens in the states of Saxony and Thuringia. Analysing the social make-up of the observational networks – consisting of a typical mixture of amateur and professional scientists –, my paper highlights the conceptual and material consequences of such collecting activities. The practices of collecting, mapping and preserving local nature and culture, I argue, created a specific emotional tie to landscapes: a particular feeling for "Heimat". Simultaneously, it allowed ecological observations to circulate beyond academic discourses. With its spill-over to the nature conservation movement, the interactions of amateur and professional observers with local environments had long-lasting political and cultural consequences beyond the field of ecology.

Marina LOSKUTOVA | Institute for the History of Science and Technology, Russian Academy of Sciences, St Petersburg, Russia

Early research on insect pests in Russia: local knowledge, academic scholarship, public initiative and the Russian civil service in the 1830s-1870s

The paper will examine the early history of applied entomology in Russia from the time when some branches of the Russian civil service began collecting field data on insect pests till the moment when the first professional positions for agricultural entomologists were established in some regions of the Russian empire. Little or no attention has so far been paid to these efforts by historians of science who studied the 19th century research in applied entomology, since their perspective has been traditionally framed by the history of the discipline's institutionalisation. The paper aspires to show that as early as in the 1840s, much effort was applied to accumulating data on the outbreaks of insect pests in the Russian empire. These efforts were initiated and supervised by civil servants, who were able to rely on expertise of prominent naturalists, both in Russia and abroad. However the nature of the project required mass field observations that could be carried out only by people with basic skills of entomological research. It was precisely this problem of converting local knowledge into the data matching scientific criteria that proved to be most difficult to solve, or even to comprehend its scope. Yet in the 1840s – early 1850s some branches of the Russian civil service aided by a few scholars at the Imperial Academy of Sciences were able to improve the quality of field data produced by their personnel and voluntary assistants in the provinces by providing detailed instructions and publishing reference literature on insect pests. However this mode of interaction among the Russian civil service, a few leading naturalists of imperial and international reputation and provincial correspondents did not survive the middle decades of the century when a whole series of political, social and economic reforms had had serious repercussion for academic research and public life in the capital and in the provinces. The paper will explore in details the reasons that prompted both the Russian entomological society at St. Petersburg and those branches of the civil service that had been engaged in collecting data on insect pests to withdraw from this field, thus ceding the initiative to local authorities and professional naturalists in the southern Russia, who in the next few decades would become the primary force behind the institutionalisation of applied entomology.

Anastasia FEDOTOVA | Institute for the History of Science and Technology, Russian Academy of Sciences, St Petersburg, Russia

Towards the professionalization of applied entomology

The professionalization of applied entomology in the Russian Empire officially began in 1894 with the creation of the Bureau of Entomology as part of the Scientific Committee in the Ministry of Agriculture and State Domain. However, long before that, as early as the 1840s, the

Agricultural Department had been collecting information on pest outbreaks and on the methods by which to control them. The Ministry had also hired several experts to make inspections, answer queries of the landowners and provincial authorities, as well as to write both specialized and popular manuals. The Russian Entomological and Free Economic Societies, along with some Zemstvos, were involved in this work. By the 1870-80s several projects to create experimental stations in applied entomology were proposed, but their research programs were still quite crude. However, in the first half of the 1890s quantitative growth shifted to qualitative. First, the landowners and administrators learned the language of scientific descriptions for pest insects, a process during which their requests to entomologists became much more clear. Secondly, entomologists became familiar with the methods of plant cultivation, harvesting, storage of the yield, etc., so that their recommendations became more useful for farmers. My paper will discuss this preparatory phase in which little was accomplished towards developing effective methods of pest control, but which was still an important process of forming a common language and the formulation of specific research programs. While it would take several decades for these realities to take root in the Russian Empire, it signaled the creation of applied entomology as an professional discipline that included the specific study of life cycles and the distribution of insects – i.e. ecology. This development was one of continuous dialogue; at one end were farmers, at another, biologists. Between these two groups agronomists as well as local and central administrators functioned as mediators, but their role was no less important than the “main actors” in this process of professionalization.

S022-C

Wed 24 July, 14:00–15:30 • Uni Place 4.204

Chair: Brigitte HOPPE | Ludwig-Maximilians-University of Munich, Germany

Robert-Jan WILLE | Radboud University Nijmegen, Netherlands

~~**WITHDRAWN: Morphologists and the state: the imperial science of Paulus Hoek (1851-1914), fisheries biologist, station director and general secretary of ICES**~~

Ida STAMHUIS | Vrije Universiteit Amsterdam, Netherlands

Snapdragons and grains, mice and chickens: the two faces of the first German Genetics Institute, 1914-1930

In 1914 the *Institute for Heredity Research* in Germany was founded in Berlin as part of the *Agricultural College*. Erwin Baur (1875-1933) became the director. He decided to occupy the niche of Mendelian and Morganian genetics. This involved adopting a reductionist, quantitative and experimental approach. This approach was not only very successful from the scientific perspective, but also from the viewpoint of applications to agriculture. Baur and his scientific institute had a bond with agriculture. Baur's whole life showed his attachment to farming. He grew up on a farm. On his private estate he practised farming. His identity was shaped by his farming background. He strived after good relationships with and recognition of the German agricultural community. Baur's natural attachment to farming eased his entry into agricultural institutions and organizations. He was a member of the relevant agricultural organizations. He attended their meetings, where he sometimes gave lectures and participated in discussions. And the experimental organisms that were used in his institute were often of interest for agriculture. His scientific staff was often paid by agricultural organizations. Mutual recognition of their common agricultural identity between him and the leadership of the Agricultural College will also have eased his entry into the Agricultural College.

The new field of knowledge had therefore two faces: it was on the one hand a science, but on the other hand it was inextricably linked to agriculture. Baur sought and found recognition in agricultural as well as scientific organizations. The experiments conducted at his institute were carried out on agriculturally interesting plants and animals, like grains and chickens, or mainly scientifically relevant ones, like snapdragons and mice. The aim of the investigations was sometimes agricultural, sometimes scientific. The *Institute for Heredity Research* had many of the characteristics of a farm and many of the characteristics of a scientific institute. It is relevant to realize that an institute with these characteristics became the most prominent one in the world of genetics in Germany the 1920s and that it was the vehicle through which, in Germany, the discipline of genetics emerged and became established. I will demonstrate the two faces of the first German genetics institute by discussing its emergence, rise, its heyday and decline.

Victoria LEE | Princeton University, United States

Mold cultures: traditional industry and microbial studies in early twentieth-century Japan

This paper traces the relationship between the upgrading of the sake and soy sauce industries in Japan – specifically the introduction of pure culture techniques and especially for koji (the rice mold used in traditional brewing) – and the activities of agricultural chemists in building culture collections and microbial classification in the early twentieth century. The importance of sake brewing to the country's tax revenue and economy meant that agricultural chemistry had no real equivalent in Europe or the United States, but grew into the largest discipline in the Japanese life sciences. Within this context scientists, especially at Tokyo Imperial University's Department of Agricultural Chemistry and the national Brewing Experimentation Station run by the Ministry of Finance, collected strains from tanekoji makers across the country who produced koji starter for the traditional brewing industry, since koji (*Aspergillus oryzae*, the rice mold necessary for making sake, soy sauce and miso) had been domesticated in breweries for centuries and did not exist in the wild. Their studies attempted to understand which microbe types were 'useful' and 'harmful' for the brewing process, as well as to classify them in accordance with international systems of taxonomy. At the same time, tanekoji makers had held long-established practices of culturing, selecting and preserving 'good' mold types as purely as possible. As these practices were upgraded by research on microbes and Pasteurian practices of pure culture, the ability to produce and sell pure-cultured microbial strains under scientific brand names altered the tanekoji industry. By tracing these transformations in the decades after 1900, the paper examines how natural historical studies of microbes in Japan both incorporated knowledge from and affected the traditional brewing industries.

Jonathan OLDFIELD | University of Glasgow, United Kingdom

Russian geography and the Commission for the Study of the Natural Productive Forces of Russia (KEPS)

This paper aims to explore the activities of the Permanent Commission for the Study of the Natural Productive Forces of Russia (KEPS), which was established in 1915, and its links with the development of Russia's geographical sciences during the late tsarist and early Soviet periods. The natural philosopher Vladimir Ivanovich Vernadskii [1863-1945] was a key figure behind the establishment of the Commission which was broadly concerned with establishing the extent of Russia's natural resources via extensive expeditionary activities. A range of scientific institutions emerged in tandem with the work of KEPS. For our purposes, it was the foundation of the Department for the Industrial-geographical Study of Russia (DIGS) in 1918, following the proposal of the geographer A.A. Grigor'ev [1883-1968], which forms a key focus. Grigor'ev's rationale for promoting this departmental specialisation was predicated on his belief that for the 'correct and rationale organisation of

the economy, it was necessary to create not only a clear picture of the natural, domestic and economic conditions of the country but also to explain the causal dependencies between them' (Kotlyakov, 2008, p. 12). Such concerns echoed, at least in part, the debates at the time over the nature and focus of geography within Russia. Furthermore, Grigor'ev's initiative would lay the foundations for the later establishment of the Institute of Geography, Academy of Sciences USSR, in the 1930s. After outlining the general work of KEPS, the paper reflects on the activities of DIGS as well as its broader role in the development of Soviet geography. It also explores the links between the rationale underpinning the activities of DIGS and broader trends within Russian geography concerning natural physical systems and 'ecological' thinking traceable to the late nineteenth century.

Denis SHAW | University of Birmingham, United Kingdom

The science behind the Great Stalin Plan (1948-1953): nineteenth- and early twentieth-century precedents

The 'Great Stalin Plan for the Transformation of Nature' was a grandiose, Communist Party and Soviet government-sponsored scheme for the amelioration of climatic conditions across the forest-steppe and steppe vegetation zones of the European USSR. The region which was the object of the scheme was in essence the USSR's breadbasket and it was believed that by planting a whole series of shelter belts and attendant environmental measures a significant and reliable increase in agricultural production might be secured. The entire plan was to be put into effect within fifteen years. The decree which inaugurated the plan in October 1948 claimed that it was based on the long experience of a series of scientific research institutes and of 'progressive' collective and state farms in the study of the local environment and in the practical work of ameliorating and cultivating forest-steppe and steppe lands. Proponents of the plan, Party propagandists and academic commentators also claimed that the scientific basis of the plan lay in the research of nineteenth and early twentieth century scholars like V. V. Dokuchaev, P. A. Kostychev, G. N. Vysotskii and V. R. Vil'yams. Thus the impression was given that the plan, rather than being an emergency measure introduced in conditions of post-war crisis, had a solid scientific basis. However, examination of the materials produced by the scientists during the period of the Stalin Plan suggests that there were serious inadequacies in the science which lay behind the plan. In other words, the plan's cancellation after Stalin's death in 1953 stemmed not merely from problems in the implementation of its ambitious goals but also from difficulties in understanding the region's environmental complexities and in forecasting the environmental effects of specific measures. The paper will provide an overview of the scientific achievements of such nineteenth-century scholars as Dokuchaev and of the recommendations they made for environmental amelioration. The work of the field research stations established by Dokuchaev and his associates will also be considered. Finally, using evidence from the Stalin Plan period, the paper will note the extent to which the preceding science provided a solid basis for nature transformation.

S023. Wiring intelligence

Wed 24 July, 14:10–17:40 ▪ Uni Place 2.219

Symposium organisers:

Simone MÜLLER-POHL | Freie Universität Berlin, Germany

Heidi TWOREK | Harvard University, United States

Symposium abstract

Our symposium analyses the various meanings embedded in the concept of intelligence in relation to the medium of (wired and wireless) telegraphy. The papers explore how telegraphy interacted with and redefined multiple aspects of intelligence from espionage to engineering.

Indeed, these papers will show that the relationship between telegraphy and intelligence reconstituted the place of science and technological knowledge in society and the state. The role of intelligence in telegraphy is multifaceted: it encompasses not only the production and appropriation of knowledge on telegraphy, but also the dissemination and use of information sent through the telegraph. Two papers will focus on the production of telegraphic knowledge within the contested realm between amateurs and experts. Nikolaas Hofmann (Freie Universität, Berlin) will examine how the military and radio amateurs built up international networks of knowledge exchange through the example of the emergence and use of wireless telegraphy in Argentina. Dr. des. Simone Müller-Pohl (Freie Universität, Berlin) will use the controversies surrounding the growing distinction through professionalization between telegraph engineer and telegraph operator to show how telegraphy contributed to the increasing professionalization of scientific knowledge in the late nineteenth century. Two other papers will focus on the products of intelligence in relation to telegraphy as technology-in-use. Dr. Heidi Tworek (Harvard University) will explore the equivocal definition of intelligence as both espionage and information in Germany during World War I. Her paper will show how war created a greater need for particular types of intelligence and influenced innovations in wireless telegraphy, while techniques and personnel from espionage divisions managed wireless news supplied by Germans across the globe. Catherine Davies (Freie Universität, Berlin) will analyse the interplay of 'old' and 'new' technologies in the creation and management of confidence through financial intelligence during the financial crisis of 1873. However, intelligence was not only concerned with the production or dissemination of knowledge; intelligence could also take on a spiritual meaning. In his paper Dr. Richard Noakes (University of Exeter) will revisit the role of telegraphy in nineteenth- and twentieth-century thinking about 'occult' forms of communication such as clairvoyance and telepathy. These widespread debates on the 'occult' exemplify the processes of cultural appropriation of telegraphy as a medium of transcendence and production of occult or spiritual knowledge. Each of these papers will contribute to creating a more nuanced picture of the use and appropriation of telegraphic technology in shaping the myriad meanings of intelligence.

S023-A

Wed 24 July, 14:10–15:40 ▪ Uni Place 2.219

Chair: Graeme GOODAY | University of Leeds, United Kingdom

Simone MÜLLER-POHL | Freie Universität Berlin, Germany

'So, who's the inventor here?' Professionalizing and standardizing telegraphic knowledge in the late nineteenth century

The latter half of the nineteenth century marks an important period in the professionalization of telegraphic knowledge further establishing the distinction between science and technology as well incremental and theoretical research. Parameters were established as to how 'intelligence' concerning the wires was to be gathered and distributed. This was no unanimous process, but invoked controversies between telegraph 'engineers' and 'technicians' as well as between the remote cable stations around the globe's 'peripheries' and the cable companies' headquarters in London. In 1879 for instance, Ezra Weedon, superintendent at the Heart's Content submarine cable station broke loose an argument with Henry Weaver, managing director of the Anglo-American Telegraph Company in London suggesting 'improvements' to Joseph Stearn's duplex set-up. This paper will use the controversies surrounding the growing distinction through professionalization between telegraph engineer and telegraph operator to show how telegraphy contributed to the increasing professionalization of scientific knowledge in the late nineteenth century.

Heather ELLIS | Liverpool Hope University, United Kingdom

Marconi, masculinity and the 'heroic age of science': transnational wireless telegraphy at the British Association meeting, 1899

In September 1899, at the annual meeting of the British Association for the Advancement of Science in Dover, Guglielmo Marconi successfully demonstrated wireless telegraphy across the English Channel (and across a national border) for the first time. Although an important achievement in purely scientific terms, the transmission was also a highly effective performance of scientific masculinity. Carefully inscenated and carried out before a large public audience and assembled journalists as well as the most important denizens of the international scientific community, the transmission was hailed in the press as heralding a new 'heroic age of science' and 'masculine reason.'

When placed in the context of the history of the British Association, this event can be seen as emblematic of an increasingly popular attitude towards science as a peculiarly masculine practice, which had to be repeatedly performed and acknowledged. A range of audiences and performance spaces were key to this process including provincial scientific societies in Britain, the ancient English universities of Oxford and Cambridge as well as the British government. Most important, however, were transnational spaces – and transnational networks, both within and outside the boundaries of empire. Scientific masculinity was defined, perhaps, above all, by its inter- and trans-national status, its most important audience being the international scientific community.

As this paper will argue, the last decades of the nineteenth century and the early years of the twentieth witnessed a parallel development in the history of the British Association. On the one hand, the language of masculinity and gender became ever more important in the self-fashioning of individual scientific members and the Association as an organisation; at the same time, its activities (although cosmopolitan from its beginnings in the early 1830s) became increasingly international and transnational in nature. Meetings were held regularly overseas for the first time (in North America, South Africa and Australia); joint meetings were held with other national scientific associations such as the American Association for the Advancement of Science. Indeed, Marconi's trans-channel transmissions were received on the other side by French scientists at the annual meeting of the *Association scientifique française* which had been deliberately scheduled to coincide with the British meeting at Dover for the purpose.

Commentary: Graeme GOODAY | University of Leeds, United Kingdom

S023-B

Wed 24 July, 16:10–17:40 • Uni Place 2.219

Chair: Jon AGAR | University College London, United Kingdom

Richard NOAKES | University of Exeter, United Kingdom

Telegraphy and telepathy: occult possibilities of electrical communication, 1870-1930

In *When Old Technologies Were New* (1988) Carolyn Marvin wrote that nineteenth century electrical communications offer a 'keenly focused view of the process of social adjustment around new technology'. This process included fantasies, hopes and anxieties about the body and the community: the electric telegraph, telephone and wireless changed ideas about what individuals and societies might be able to achieve. Scholarly engagement with this issue has tended to focus on the imagined and actual consequences of electrical communication on physical health, social mobility, urban transformation, global trade, diplomacy and international politics. However, comparatively little systematic attention has been paid to the ways in which debates about electrical communication proved so fertile for fantasies about, and attempts to produce scientific evidence for, obscure powers of the mind and body

such as telepathy. For some, these cultivation of these powers foreshadowed a 'brotherhood of man' even more sublime than those in utopian fantasies of electrical communication.

This paper looks at the ways in which electrical communication can help develop current understanding of the cultural places of nineteenth and early twentieth century beliefs and practices commonly grouped under the terms 'occult' and 'esoteric'. It traces the complex uses to which mesmerists, spiritualists, psychical researchers and proponents of Modern Theosophy appropriated the new languages, concepts and practices of electrical communication. Analogies between the electric and the 'celestial' or 'spiritual' telegraph, and between psychic and wireless telegraphy, were just some of the ways in which scientific credibility was sought for occult forms of communication. But electrical communication was also important to critics of these ideas: for example, some British and American physicists and electrical engineers saw electrical theories or 'brain wave' theories of telepathy as a way of rendering this alleged mental faculty less 'spiritual' and 'occult', and more an exciting direction in which to extend physical theories. All too often studies of these occult borrowings (such as Jeffrey Sconce's otherwise excellent *Haunted Media* (2000)) see the traffic between electrical and occult communication as uni-directional. This paper concludes by suggesting that occult communication may have provided fertile material for exploring the possibilities of its better-known electrical counterpart.

Catherine DAVIES | Freie Universität Berlin, Germany

Spreading fear, communicating trust: writing letters and telegrams during the panic of 1873

My paper analyses the use of telegraphy during the 1873 financial panic and gauges its significance in comparison to other, more traditional forms of communication. When the New York bank Jay Cooke & Co. announced that it was suspending its operations, the news quickly spread around the globe. American wire reports were anxiously awaited in Europe and parsed for indications of the true extent of the panic. Sensing the danger of contagion, newspapers in some instances delayed the publication of certain telegrams and pointed out that some of them contained erroneous information and should not be taken at face value. At the same time, traditional communication by letter still played an important role, especially at the local/national level. When George Opdyke of New York City found himself confronted with rumours that his bank had suspended payments, he began writing letters to his correspondents in New York and beyond, informing them that his bank was sound and was meeting all its obligations. Such assurances, penned in ink, proved effective in re-establishing his credentials and, I argue, probably carried greater weight than sparsely worded, impersonal telegrams would have done.

Heidi TWOREK | Harvard University, United States

Spying for information: German espionage and news in World War I

In 1924, Colonel Walter Nicolai (1873-1947), Chief of the German Secret Service (Section IIIB) between 1913 and 1919, deplored the German population's constant misunderstanding of the role of espionage and the press. The slippage was hardly surprising in many ways, as the Secret Service had controlled press policy from 1916 to the end of World War I. Still, Nicolai bemoaned the public confusion between *Nachrichtendienst* (intelligence service) and *Pressedienst* (press service). This paper will explore the origins of that confusion and trace it back to the equivocal definition of intelligence as both espionage and information in Germany during World War I. I argue that the development of wireless technology in World War I created an inextricable institutional, technological, and cultural relationship between espionage and propaganda in Germany. Institutionally, Section IIIB of the German military became responsible for both espionage and news propaganda as the war progressed. Culturally, the war created a perceived greater need for particular types of intelligence and a desire to disseminate global propaganda for the German cause. Finally, both espionage and propaganda depended

almost entirely upon innovations in wireless telegraphy. As the British had cut German telegraph cables upon the outbreak of war, Germans turned to wireless telegraphy to overcome their isolated status. German military expectations for global propaganda influenced innovations in wireless telegraphy, while techniques and personnel from espionage divisions managed global wireless news supplied by Germans. The blurred line between espionage and news continued to shape German beliefs about propaganda in the interwar period, while simultaneously forming one of the key bases for Allied skepticism of German reporting and news.

Commentary: **Jon AGAR** | University College London, United Kingdom

S025. Headwinds through the Iron Curtain: fundamental and applied sciences in Communist Eastern Europe

Mon 22 July, 11:00–17:30 ▪ Uni Place 2.218

Symposium organisers:

Luciana JINGA | Institute for the Investigation of Communist Crimes and the Memory of the Romanian Exile, Romania

Cristiana OGHINA-PAVIE | University of Angers CERHIO UMR 6258, France

Symposium abstract

The history of science in the countries of the Eastern bloc between 1945 and 1989 was a field of confrontation between opposing influences. In the early years of communism, the traditional relations with the West have been interrupted and Soviet scientists have become the essential references. Nevertheless, the scientific blockage was suspended by unexpected periods of opening during which certain sciences that had been annihilated (such as sociology, genetics) were restored as academic disciplines, while international networks were reactivated. The timeline of these different waves of influence, specific for each country, is not linear and it does not cover a homogeneous reality. Stalinization, de-Stalinization, national resistance and nationalist movements have influenced the degree of autonomy of science from political power. Moreover, an energetic refusal with respect to the “pure” science led to an active orientation of the research toward the fields of application.

This symposium aims to address the conflicting influences exerted on the various sciences (experimental, social or exact sciences, humanities) in all the countries from the Eastern bloc. In response to the overall theme of the Congress, Knowledge at work, the symposium wish to highlight the areas of applied science. Did they really use the Soviet methods during fieldwork, or just a scientific rhetoric that was accepted by the regime? In the case of agriculture, was there a difference in the reception of influences between the official line of Lysenkoist biology and methods of breeding? How do the social sciences reflect the realities of each country? What was the role of science in deciding the state health politics? Experimentation, application, technologies, and medicine - are they more autonomous than the fundamental research facing ideological and political influences?

Contributions focuses on Communist countries from Eastern Europe, in order to open a discussion from an international comparative perspective. This symposium will provide the opportunity to create an international network, the aim of which is to develop a collective, comparative approach of the subject.

S025-A

Mon 22 July, 11:00–12:30 ▪ Uni Place 2.218

Chair: **Luciana JINGA** | Institute for the Investigation of Communist Crimes and the Memory of the Romanian Exile, Romania

Stéphane TIRARD | Centre Francois Viete University of Nantes France, France

Lepeshinskaya’s concept of the cell: pseudo-scientific work or political strategy?

This paper presents the work in cell biology of the Soviet biologist Olga Lepeshinskaya (1871-1963) and analyzes the circumstances of its diffusion outside the USSR, after World War II. Lepeshinskaya’s work was produced in the context of Lyssenkoist science and was in strong opposition with the principle of the impossibility of spontaneous generation. The aim of this study is to analyze the manner in which such ideas were able or not to circulate and what background of their critics were.

The first part will present Lepeshinskaya’s conceptions of the cell and of life in the general context of the Soviet science, with particular regard to the topic of the origins of life. The second part will inform on the reception of these ideas outside the USSR. Finally, it will analyze the rhetorical and editorial strategies of such contestable ideas.

Piotr KÖHLER | Jagiellonian University, Poland

Lysenkoism in biological textbooks in Poland

The appearance of Lysenkoism in biological textbooks in Poland was preceded by a flurry of events of a political nature. A council of educational activists of the Polish Workers’ Party (30 October 1948) ordered, among other things, the revision of curricula at all levels of education with the object of “thorough removal of the influence of reactionary ideology and the filling of the curricula with the ideology of historical materialism.”

The First National Congress of School Inspectors (29 May 1949) established that the scientific worldview would henceforth be the basis for teaching in Polish schools. The Central Course for Biology Teachers (17–19 June 1949) replaced school genetics curricula with Michurin-Lysenko theory. A revision of biology curricula was carried out. Starting with the school year 1949/1950, in place of genetics, “rudiments of evolutionism,” including Lysenkoism, were introduced into the curricula.

Initially, there were no suitable textbooks in Polish. A Soviet textbook “Principles of Darwinism” by Melnikov, Shibanov and Korsunskaya was soon translated into Polish. This book went through seven editions in Poland. February 1953 saw the release of a manual for the methodical teaching of biology in classes V-VIII of general primary schools. The main objectives of teaching biology at that time were: to convince pupils of the materialist worldview, and then to ensure that this worldview took root.

Genetics was restored to the curriculum in schools at the beginning of the school year 1957/1958.

The purpose of my presentation is to examine whether indeed Mendelism (genetics) disappeared from the teaching of biology in Polish schools. Was it possible to teach genetics during the era of Lysenkoism in Poland?

Cristiana OGHINA-PAVIE | University of Angers CERHIO UMR 6258, France

Plant breeding versus evolution in Romania (1948-1965): complementarities and contradictions

Between 1948 and 1965, the lysenkoist pattern in Romanian biology imposed a new status of agronomic research, as “practical, useful and proletarian” applications of the evolutionary theories. The entire academic organisation of the biological sciences was thus founded on

the priority of the applied sciences on fundamental knowledge. Nevertheless, all the agronomic work could be done in conformity with the specific synthesis of theories of evolution made by Lysenko.

Plant breeding was particularly concerned with the tension between practice and theory. We will analyse in parallel technical works on plant breeding and theoretical writings in "general biology" published in this period. Which were the influences of the Darwinian and Neo-lamarckian concepts on the manner in which the Romanian biologists adopted and adapted lysenkoism? Were there any consequences of their scientific training in Western universities before World War II? Was ideology more present in theoretical works than in application?

Our claim is to show how artificial selection reflected the ambiguities of lysenkoism in the particular case of Romanian biology.

Alexandru S. BOLOGA | Academy of Romanian Scientists
Section of Biological Sciences / Romanian Committee of History and Philosophy of Science and Technology, Subcommittee
Constantza, Romania

Biology under communist rule: preserving professional ethics

In everlasting tribute to their braveness and memory

During the era of communist rule, some valuable scientists underwent the rigors of this criminal and antidemocratic regime. The praise of Russian/Soviet biologists and physicians, was mandatory. Instead, e.g., the founders of genetics were denigrated and minimized. But this evil period of Romanian national history y compris its history of biology also bore witness to illustrious personalities, for their education, professionalism, patriotism, morality and culture, outspoken or implicitly opposing this regime which marked and relegated Romania to the backstage of history for five decades. These remarkable specialists and experts in various fields of biology, affirmed both nationally and most of them also internationally, suffered from persecutions in different ways, for their own anticommunist beliefs. They were prevented from practicing their profession in higher education or research, deprived of civil rights, convicted, with or without trial, sent as political prisoners, to prison or labor camps, with punishment up to death, or forced to emigrate. The National Council for the Study of the Archives of the Security has enabled access to the individual tracking files, of different durations, of Alexandru Borza (1887-1971), Constantin Motas (1887-1971), Ioan G. Botez (1892-1953), Teodor Busnitza (1900-1977, Constantin S. Antonescu (1902-1981), Zaharia Popovici (1907-?) and Victor Angelescu (1912-2002), Petre T. Banarescu (1921-2009), Nicolae A. Boscaiu (1925-2009), Denis Buican (1936). This contribution, based on CNSAS archival research with the consent of those alive and/or of their descendants, is dedicated in memoriam to above named Romanian outstanding anticommunist biologists, as memento to their undeserved professional, family and private sufferings, humiliations and unfulfillments because of the repressive regime.

S025-B

Mon 22 July, 14:00–15:30 ▪ Uni Place 2.218

Chair: Cristiana OGHINA-PAVIE | University of Angers
CERHIO UMR 6258, France

Luciana JINGA | Institute for the Investigation of Communist Crimes and the Memory of the Romanian Exile, Romania

A failure of socialist medicine: the pro-natalist policy during Nicolae Ceausescu's regime

An important part of the communist propaganda, after 1945, was the establishment of nationwide, easy accessible, entirely free of charge, healthcare system. In order to achieve this purpose, the communist party expanded the medical network by opening new hospitals, clinics, Multidisciplinary teams have been introduced into general practice. In order to rapidly increase the medical personnel needed in the system,

new medical schools have been created. In terms of medical care provided to its population, communist Romania had very clear objectives, among which: reducing tuberculosis incidence, reducing child mortality, the eradication of infectious diseases such as polio or malaria. Special measures concerned maternal and child healthcare, in order to reduce both infant and obstetric mortality, as well as birth defects. Nevertheless, the main objectives, the essential priorities have all been set more by economic and political requirements than by purely medical consideration. The Romanian communist regime, especially in the 1980', due to unprecedented budget cuts, did not succeeded in ensuring equitable access, the necessary supply and distribution of the primary workforce for the medical system. Corroborated with the demographic concerns of Nicolae Ceausescu's regime, the Romanian communist healthcare system became just another piece in the dictatorial machinery. The instrumentalisation of the Romanian medical system had tragic consequences, such as higher rates of infant and child mortality than any other European country at that time, high rates of obstetrical mortality, an important number of illegal abortions and, as consequence, of maternal deaths.

Corina DOBOS | UCL/ University of Bucharest, Romania

Pavlovian reinterpretations: medicine and ideology in 1950s Romania

The paper focuses on the major epistemological shifts that the relationship between medicine and politics in the first decade of Communist rule in Romania. Under the authority of the Pavlovian principles promoted by High Stalinism, the 1950s in Romanian medicine were generally marked by Pavlov's teaching on "theory of higher nervous activity" and of dynamic localization of brain's functions, providing a strong pathological physiology for discussing and treating mental illness in recurrent terms as "protective inhibition", "sleep therapy", "stimulative therapy". Inspired not only by Pavlov, but also by the works of I.M. Secenov, S.S. Korsakov or V.M. Bechterev, Romanian medicine in general, psychiatry, neurology and physiology in particular were subsumed to neurology and psychopathology and was redefined as a branch of natural sciences. Simultaneously, the '50s were characterized by a denunciation of the "bourgeois" idealistic and decadent medical concepts and practices, "psychomorphology", "psychoanalysis" and "existential psychology" being particularly demonized.

This Pavlovian "break" in medicine created the opportunity for doctors to accede to new resources of research and higher professional status. Taking advantage by the new opportunities of medical research created in Romania after the Second World War by the communist rulers, leading interwar scientists (Parhon, Danielopolu, Kernbach) hurried to prove their loyalty towards the emerging communist regime in the country, and were ready to publicly reinterpret their work in Pavlovian terms. The paper deals with two scientific congresses discussing the Pavlovian reinterpretation of the history of Romanian medicine and future perspectives organized by the Romanian Academy in 1952, 1956 respectively. The research argues that the enthusiasm Romanian doctors showed in openly embracing the Pavlovian principles is to be understood instrumentally for getting access to new professional and symbolic resources.

Bradley MOORE | University of Wisconsin-Madison, United States

A western impulse in eastern garb: the cultural and scientific dynamics of communist public health in Czechoslovakia, 1948-1958

The Stalinization of medical practice demanded an explicit focus on preventative measures, a dialectical-materialist perspective, and the direct incorporation of a "Pavlovian" physiological approach which embraced the unity of man and environment. These imperatives aligned smoothly with various public health trends from the Interwar period in Czechoslovakia, and the effort to create a Soviet-style state hygiene

service encountered a small but ready cohort of physicians whose existing structuralist and environmental health concerns found augmentation within the precepts of Marxist-Leninist medicine. Rather than suspending or eschewing Western traditions, a socialist approach to public health revitalized and empowered long-held progressive critiques of therapy-centered medicine, the uncontrolled nature of industrialization, and the unsanitary state of Czechoslovakia's living and working environment.

The precepts of Pavlovian medicine, based largely on an amalgamation of dialectical-materialist philosophy and the theory of conditioned reflexes, placed the source of internal biophysical change in the external environment: population health was primarily an outcome of a society's living and working conditions. These natural, physical, and material influences therefore required hygienic transformation in order to enhance the health of the proletariat, eradicate the sources of illness and disease, and develop salubrious conditions for work and daily life. Although this perspective moved Czechoslovak hygienists away from the socio-behavioral focus of most contemporary post-war public health work in the West, there was consistent interest in more structuralist Western scientific research and medical practices in the areas of toxicology, occupational health and hygiene, ergonomics, physiology, environmental pollution, and sanitary design. There was little hesitation to site foreign, bourgeois sources on these issues, and better established medical journals never ceased producing abstracts in English or French throughout the "high Stalinist" period of scientific intervention (1945-1953). The result was a medical discipline which did not experience an interruption by the communist milieu so much as a refraction and magnification of specific yet traditional interests and aims.

S025-C

Mon 22 July, 16:00–17:30 ▪ Uni Place 2.218

Chair: Stéphane TIRARD | Centre Francois Viete University of Nantes France, France

Jean-Philippe MARTINEZ | Université Paris Diderot - Paris 7, France

Lev Landau: une physique théorique « purement pratique »

Lev Landau est l'un des principaux acteurs de la physique soviétique du début du XXème siècle, son influence n'est aujourd'hui plus à démontrer. Après quelques années au contact des plus grands de son époque (Bohr, Pauli...) en Europe de l'Ouest, il rentre en URSS soucieux d'y développer une physique théorique de qualité. Son impact se traduit non seulement par la rédaction des célèbres Cours de physique théorique, mais aussi par l'organisation d'une école formant toute une génération de théoriciens. Ses travaux sur l'état condensé de la matière lui valent en 1962 un prix Nobel. Ils sont le fruit d'une étroite collaboration avec Piotr Kapitsa, physicien reconnu pour ses activités dans le domaine appliqué. Cette collaboration est symbolique de la conception de la physique théorique qui anime Landau : elle ne peut s'exercer qu'en étroite communion avec la physique appliquée. Peu étonnant pour un scientifique marxiste, mais véritable support dans notre contexte du double jeu du physicien confronté à la réalité du politique et de sa discipline. Sa valorisation d'une physique théorique « purement pratique », rhétorique acceptable pour le pouvoir, ne se fait pas au sens de « appliquée » mais plutôt dans celui d'une discipline peu concernée par la physique des principes. L'appui que prennent les théoriciens sur la physique appliquée est valorisé dans les deux grands lieux de la physique moscovite où Landau exerce son influence après-guerre : l'Institut de physique théorique et expérimentale et l'Institut pour les problèmes physiques. On y pratique une recherche fondamentale considérée par beaucoup comme trop abstraite, tout en répondant aux exigences de la physique appliquée, afin de suivre le credo d'une science au service de la construction socialiste. Les théoriciens, au cœur d'enjeux nationaux considérables (recherche nucléaire, conquête

spatiale), y gagnent alors en autonomie en répondant aux attentes multiples du régime soviétique. La création en 1965 d'un centre uniquement dédié à la physique théorique, l'Institut Landau, en est une confirmation. En somme l'objet de cette communication est de montrer comment au travers des deux instituts suscités, l'influence d'un personnage charismatique comme Landau a permis à une communauté de physiciens théoriciens de s'épanouir. Le tout malgré le peu de considération, d'un point de vue du moins idéologique, du régime soviétique à l'égard de la science « pure ».

Sarah MARKS | University College London, United Kingdom

Rewriting Marxism for the computer age: the 'scientific-technical revolution' in Cold War Czechoslovakia and East Germany

"...it is only possible to achieve real liberation in the real world and by employing real means, that slavery cannot be abolished without the steam-engine and the mule and spinning-jenny, serfdom cannot be abolished without improved agriculture, and that, in general, people cannot be liberated as long as they are unable to obtain food and drink, housing and clothing in adequate quality and quantity. "Liberation" is an historical and not a mental act, and it is brought about by historical conditions, the development of industry, commerce, agriculture..." Karl Marx, *The German Ideology*, 1845 During the 1960s, publications from across all academic disciplines in the USSR and its satellite countries were making frequent reference to the 'scientific-technological revolution'. Not only had science and technology become a primary means of demonstrating the successes of the socialist system on the international stage of the Cold War, but they were becoming inscribed as 'force of production' that could be utilized in the process of achieving a true communist society. This paper will draw from archival papers, academic publications, propaganda literature and CIA intelligence reports to explore how the concept of the scientific technological revolution was used by senior Communist Party officials and academics in East Germany and Czechoslovakia in the 1960s and '70s, as a means to update and reinterpret Marxist theory for the modern age. The term 'Scientific-Technical Revolution' was first coined by the British Marxist scientist J.D. Bernal in his 1957 edition of *Science in History* to describe a perceived second scientific revolution in the first half of the twentieth century, with the 'discovery of the nuclear atom, relativity, and the quantum theory, as well as the processes of bio-chemistry and the inner structure of the cell, the electron microscope, and the electronic computing machine'. The use of these new fields, along with further innovation in science and technology, could act as an engine for historical change that could transform and liberate humanity. Such arguments were taken up enthusiastically by the scientific communities of Czechoslovakia and East Germany in particular, as a means of furthering their professional interests. Senior Party members also became involved in such debates; with rifts beginning to appear in both countries within the Party over how best to achieve a true Communist society. Those who remained in the Marxist-Leninist tradition as advocated under Stalin favoured a transformation of society through propaganda and education, with the Party essentially being responsible for producing socialist subjectivity by ideological means. In contrast, those influenced by the concept of the scientific-technical revolution advocated a focus on scientific research and industrial investment as the method through which to change the historical conditions in order to bring about a socialist liberation of humanity, drawing specifically on Marx's *German Ideology*. Central to this thesis was what CIA intelligence reports termed 'Cybernetic Revisionism'. My paper demonstrates how concepts from cybernetics came to be used by Walter Ulbricht's Party elite in the GDR, as well as by reformists in Czechoslovakia, as a solution to the social and economic problems facing both countries by the end of the 1960s. I will discuss how cybernetic concepts of self-regulation and feedback loops were appropriated by advocates of economic reforms who were dissatisfied with the performance of the centralised planned economy. By inscribing decentralisation measures in terms of the application of technology and

increasing workers' participation in the process of production, Party members were able to challenge the doctrine of centralisation whilst still maintaining a commitment to a socialist planned economy. I will also examine the increasingly utopian visions of a socialist future conjured by the possibilities of computer technologies and automatization, whereby workers would be liberated from manual work and thus enabled to fulfil their 'human potential' in more intellectual and scientific pursuits. In conclusion, I argue that such 'cybernetic revisionism' was crucial to understanding the history of Central and East European socialism in the 1960s, and played an often overlooked but fundamental role in the Prague Spring reform movement in 1968.

Elena KOCHETKOVA | European University at Saint-Petersburg, Russia

Western technologies and Soviet modernization, 1953-1964: Svetogorsk pulp and paper factory

My paper aims at studying the role which Western knowledge played in the Soviet Union during the Cold War despite the iron curtain. I consider the period of 1953 – 1964 which was the time of so called industrial modernization initiated by the Soviet leader Nikita Khrushchev. The aim of modernization was to increase production, renew facilities and provide positive changes in outdated industries. This task, however, was very complicated to be completed in the post-war country because of lack of specialists and produced facilities. This forced the leadership to apply for the Western help under the idea of so called peaceful co-existence. This idea had to provide possibilities for studying and purchasing Western technologies via official trips by Soviet specialists to Finland, West Germany and other countries. I emphasize technology transfer into the pulp and paper industry which was significant but backward branch of the Soviet economy. I aim at studying the local level, i.e. seeing how the achievements of the government were introduced into a certain factory. That is why I focus on a case of Svetogorsk pulp and paper plant which was a former Finnish factory annexed by the Soviet Union after the Soviet-Finnish war of 1941 – 1944. I study how Western technologies were brought to a "former" capitalist enterprise and pay a specific attention to ways knowledge was transferred and used. I focus on ways Soviet specialists got technical knowledge and obtained particular skills being abroad on their business trips and implemented them in the Soviet Union later. On the one hand, I am interested in what technologies were transferred and implemented successfully and what role these technologies played in the Khrushchev's modernization. On the other hand, I am analyzing reasons of technology transfer failures. I consider technologies and specialists, i.e. technological and social factors as mutually influenced each other, following Thomas Hughes, who emphasized an importance of social component of socio-technological systems for technological development. This allows to study how knowledge changed while being transferred? How did Soviet specialists deal with Western knowledge? And in general, was the Soviet Union capable to employ and adapt transferred technologies?

Commentary: Jean-Claude DUPONT | Université de Picardie Jules Verne, France

S026. Pratiques et théories dans le champ de la santé mentale: quel(s) rapport(s)?

Mon 22 July, 14:10–17:40 ▪ Uni Place 3.205

Symposium organisers:

Camille JACCARD | Université Paris 1-Panthéon Sorbonne, France

Stéphanie PACHE | Université de Lausanne, Switzerland

Symposium abstract

Ce symposium se propose de questionner les "savoirs à l'œuvre" (knowledge at work) dans le champ de la santé mentale et dans les disciplines s'y rapportant (psychiatrie, psychologie, neurologie, psychanalyse, psychothérapie ou autre approche thérapeutique en santé mentale...) Il s'agira de discuter les liens et les frontières entre les théories et les pratiques dans un contexte où les définitions de ces termes font particulièrement question, aussi bien pour les actrices eurs de ce domaine que pour les chercheurs eurs.

En effet, selon les contextes et les époques, les modèles théoriques auxquels se rattachent les pratiques thérapeutiques dans le champ de la santé mentale ne se revendiquent pas nécessairement d'une légitimité scientifique, même à notre époque où la science semble dominer la médecine et les soins. D'autre part de nombreuses connaissances scientifiques n'ont pas été "traduites" en pratiques. Réciproquement le fait de se référer à des connaissances scientifiques produites en dehors de la clinique n'est pas une condition sine qua non de la pratique thérapeutique et procède souvent de médiations qu'il serait riche d'analyser. A cet égard, l'étude des parcours biographiques et professionnels des actrices et acteurs de la santé mentale, notamment, pourra s'avérer fructueuse pour penser les modalités de ces échanges et de ces transferts.

En ce qui concerne l'historiographie de cette problématique, il pourra être intéressant de reconsidérer les concepts des études socio-historiques des sciences dans ce domaine. La question posée par la notion de clinique, par exemple, et la conceptualisation qu'en propose Foucault, fréquemment cité dans ces études, mériteraient notre attention. En outre, l'articulation des questions posées par la production théorique et scientifique avec celles des enjeux sociaux et politiques des pratiques thérapeutiques sera l'occasion de réfléchir aux modalités de production des normes définissant le normal et de pathologique, en croisant l'analyse de leur production scientifique et celle de leur rôle dans les institutions sociales. A cet égard les travaux portant sur une analyse de leurs usages en contextes variés, notamment tels que ces termes sont utilisés en santé mentale et tels qu'ils apparaissent dans l'épistémologie, sont également bienvenus.

S026-A

Mon 22 July, 14:10–15:40 ▪ Uni Place 3.205

Chair: Camille JACCARD | Université Paris 1-Panthéon Sorbonne, France

Stéphanie PACHE | Université de Lausanne, Switzerland

Pratiques et théories dans le champ de la santé mentale: quelle discussion?

Notre contribution doit permettre d'introduire les questions que ce symposium a pour projet de traiter et de proposer un cadre à cette discussion. Il s'agit pour nous de présenter les écueils épistémologiques et méthodologiques qui ont soulevés des interrogations de notre part dans le cadre de nos travaux et nous ont encouragées à vous proposer cette rencontre. L'histoire de la santé mentale a pour particularité (mais non spécificité) d'être, en partie non négligeable, écrite par les acteurs et actrices qui la font. Nombre de praticien·ne·s, mais aussi des praticien·e·s y ont contribué et y contribuent. Ce simple fait nous interroge sur le rapport qu'entretiennent nos sources, bien (trop ?) souvent « savantes », avec la réalité des pratiques, ainsi que le caractère quelque peu artificiel de théories présentées comme séparées des pratiques. Un corollaire de ce rapport étroit entre pratiques, production de savoirs, et histoire de ces savoirs et pratiques se manifeste dans l'intérêt, ou le désintérêt, manifesté par les praticiens à l'égard des études sociales et historiques des sciences. Ainsi se pose une autre question reprenant la séparation construite entre « théories et pratiques », celle des rapports entre celles et ceux qui font ces études — « qui théorisent » — et celles et ceux qui ont des pratiques dans le champ de la santé mentale — « qui agissent

». Ce symposium représente à nos yeux une occasion d'ouvrir une discussion plus générale sur ces « effets » de narration, cette apparente répartition des rôles, et ce qui nous permet en tant que chercheuses et chercheurs d'approcher au plus près la réalité des rapports entre pratiques et théories.

Francesca ARENA | Université d'Aix-Marseille, France

Théories et pratiques autour du diagnostic de folie puerpérale XIXe-XXe siècles

A partir de la fin du XVIIIe siècle des sciences qui prennent alors leur essor en tant que nouvelles disciplines, réfléchissent en même temps à la question de la maternité et de ses dérèglements. Cette réflexion sur la maternité et ses maladies, dont la folie, permet en effet une réflexion plus générale sur l'épistémologie des disciplines car elle conduit les médecins au cœur de la séparation entre pathologique/physiologique et organique/moral. C'est notamment le cas de l'aliénisme au XIXe siècle avec l'élaboration du diagnostic sur la folie puerpérale. De manière analogue, mais antithétique, à l'hystérie, la folie puerpérale permet une réflexion spéculative sur la morbidité du corps et de l'esprit de la femme. Folie de la grossesse, des suites des couches et de l'allaitement, la folie puerpérale est d'abord confondue avec les délires des infections du post partum (la fièvre puerpérale) et progressivement rattachée au comportement de la mère (bizarreries, mélancolie, violence). En revanche lorsque l'on regarde aux pratiques d'internement à l'asile durant la même époque (à Marseille et à Florence) on se rend compte que l'usage du diagnostic de la folie puerpérale est assez arbitraire. En effet pour la plupart des femmes internées on évoque des raisons liées à la vie reproductive : règles, grossesse, accouchement, allaitement, ménopause sont souvent des causes concomitantes dans l'origine de la folie. L'asile semble ainsi peu perméable aux débats théoriques de l'aliénisme et de la psychiatrie : les contraintes de l'internement semblent relever plutôt des dynamiques sociales de genre, de classe et de race. La folie puerpérale et les diagnostics qui la replacent au cours au XXe siècle restent cependant centraux dans la réflexion psychiatrique pour signaler les dysfonctionnements psychiques de la maternité. Toutefois encore aujourd'hui les sciences médicales n'ont pas trouvé un consensus : l'origine de la folie maternelle, organique ou psychique, est encore questionnée et sa définition (baby blues, dépression post natale et psychose puerpérale) demeure changeante selon les interprétations et les pays.

Emmanuel DELILLE | Institut für Geschichte der Medizin, Berlin, Germany

Les « psychoses débutantes » comme catégorie productrice de normes et lieu d'observation privilégié des interactions entre doctrines psychopathologiques et pratique

La catégorie de "psychose débutante" fait partie des classifications médicales usuelles, à la fois au seuil des savoirs qui constituent l'ossature du champ de la santé mentale, et catégorie normative, susceptible de donner un sens médical à un ensemble de conduites d'abord identifiées comme bizarreries de comportements, propos, émotions et états mentaux étranges, puis requalifiées en tant que prodromes d'une maladie mentale. Notre objectif est de replacer le problème des psychoses débutantes au sein d'une histoire croisée franco-allemande (selon la perspective de Michel Espagne, Michael Werner et Bénédicte Zimmermann), afin d'établir des ressemblances, des dissemblances, et les savoirs qui circulent dans le contexte de l'après-guerre jusqu'au années 1970 (Trente Glorieuse, Wirtschaftswunder). Dans un second temps, nous donnerons des exemples de son maniement dans la clinique à partir d'un type de sources encore peu employées dans l'histoire de la seconde moitié du XXe siècle: des dossiers de patients d'un centre hospitalier français (Bonneval). Ce cadre étant posé, nous procéderons à l'analyse des enchaînements entre les certificats médicaux, les premiers entretiens cliniques, le récit d'anamnèse, la construction du diagnostic, les

indications de traitement, le pronostic, etc., autant d'indices diachroniques qui offrent un lieu d'observation des savoirs impliqués – ou pas. En effet, il ne s'agit pas tant ici d'évaluer l'impact de certaines doctrines, des études longitudinales, des programmes de recherche ou des politiques publiques de prévention des troubles mentaux, que d'examiner quels sont les signes cliniques et les dichotomies conceptuelles sur lesquels les cliniciens s'appuient, de questionner les variations et ce qui motive l'usage d'outils comme les tests psychologiques. L'accent sera mis sur l'itinéraire professionnel, médical et intellectuel, des médecins-chefs, assistants, médecins étrangers en stage, internes, etc., dans les limites du centre hospitalier choisi pour cette recherche historique, en mettant en évidence les décalages chronologiques entre les travaux universitaires allemands (Klaus Conrad, Gerd Huber, etc.) et le contexte de réception français, mais aussi les phénomènes d'école, qui s'agrègent parfois sous forme d'une sociabilité savante en-dehors de l'université (Henri Ey et Conrad Stein pour le groupe de l'Évolution Psychiatrique en France).

Commentary: Cécile AUBERT | IUHMSP-Université de Lausanne, Switzerland

S026-B

Mon 22 July, 16:10–17:40 • Uni Place 3.205

Chair: Stéphanie PACHE | Université de Lausanne, Switzerland

Emilie BOVET | Université de Lausanne, Switzerland

Visibiliser les enjeux de la recherche sur le cerveau dans la formation des futurs professionnels en santé mentale

Un des grands enjeux des tenants des neurosciences psychiatriques est de promouvoir la recherche dite « translationnelle », soit l'application des recherches au bénéfice des patients. Cet enjeu est de taille, tant le quotidien des acteurs du soin – souvent contraints à un tâtonnement thérapeutique – semble éloigné des discours prometteurs mis en avant dans la recherche sur le cerveau. Si les soignants peuvent se passer de connaissances sur le cerveau pour tenter de soulager la souffrance psychique, il serait pourtant naïf de croire que leur pratique échappe aux bouleversements institutionnels véhiculés par l'essor des neurosciences psychiatriques. En effet, même si on n'évoque que rarement le cerveau en clinique, force est de constater qu'il est omniprésent dans les protocoles de recherche translationnelle, ce qui se répercute inévitablement sur les manières d'envisager la clinique. L'appréhension du cerveau par la psychiatrie ne fait que très rarement l'objet d'une analyse historique et épistémologique dans la formation des étudiants en médecine, psychologie et soins infirmiers, ce qui tend à renforcer chez les étudiants l'idée que cette discipline vient de « découvrir » le cerveau. Il s'agira ici de réfléchir à la façon dont les études socio-historiques des neurosciences peuvent permettre aux futurs professionnels en santé mentale de prendre conscience des reconfigurations actuellement à l'œuvre dans le champ psychiatrique et de l'influence des sciences du cerveau sur cette reconfiguration. L'objectif sera notamment de souligner, à travers plusieurs exemples, l'utilité d'une formation qui prenne en compte l'histoire des liens entre clinique de la santé mentale et recherche sur le cerveau, afin d'encourager les futurs professionnels à adopter une bonne distance critique face à la place de leur pratique dans un champ psychiatrique passablement bouleversé par le nombre toujours croissant de recherches visant à « découvrir » les bases cérébrales des troubles psychiques.

Smaïl BOUAZIZ | Institut d'Histoire et de Philosophie des Sciences et des Techniques, France

Des patients agités aux maladies étudiées: la transformation du statut épistémologique du patient et de la maladie mentale

David H. Healy et J.-N. Missa ont montré qu'au cours des années 1950-1960, la 4560-RP (chlorpromazine) et du R-1625 (halopéridol) furent les principaux moteurs de la révolution théorique et pratique de la psychiatrie, qui commence alors à changer radicalement de visage. Mais dans un champ aussi complexe, l'emploi du terme de « révolution » doit être justifié, et implique de distinguer l'aspect pratique de l'aspect théorique. En clinique, les résultats de la chlorpromazine suscitent autant de circonspection que d'enthousiasme ; la diffusion mondiale du médicament se heurte à énormément de résistances. A bien y regarder, la « révolution neuroleptique » des années 1950, n'eut pas tant lieu dans la clinique que dans les façons de concevoir et d'étudier les maladies mentales. Notre hypothèse de travail est la suivante : pour comprendre en quoi on peut parler de « révolution », il faut paradoxalement se détourner de l'aspect pratique-clinique de la psychiatrie pour examiner les effets théoriques des psychotropes, et clarifier les méthodes de recherche élaborées pour comprendre la maladie mentale via l'étude des effets comportement et physiologiques des médicaments sur les patients. Car ce qui paraît avoir échappé à l'attention des historiens de la psychiatrie biologique, c'est que cette entrée subite de la maladie mentale dans le laboratoire du biologiste ne pouvait qu'entraîner un changement radical dans la signification de la notion de « malade » ou de « patient », changement décisif pour comprendre les évolutions ultérieures de la psychiatrie biologique. Nous nous intéresserons pour cela au cas du National Institute of Health : en effet, à partir de l'entrée en vigueur du « Mental Health Act », en 1955, le N.I.H. accueille un ensemble de travaux de biologie, de neurophysiologie et de pharmacologie expérimentales sans précédent. Nous montrerons comment ce changement dans le statut épistémologique du patient est intervenu dans les requalifications conceptuelles que la, ou plutôt les maladies mentales ont connues au cours de ces premiers travaux de recherche.

Elisabetta BASSO | Technische Universität Berlin, Germany

L'épistémologie clinique de Ludwig Binswanger (1881-1966): la psychiatrie comme « science du singulier »

Le choix de la méthodologie de Binswanger comme un « cas » représentatif de l'articulation de la pratique et de la théorie dans le domaine de la psychiatrie pourrait donner lieu à des objections, dans le mesure où la « Daseinsanalyse » a été souvent critiquée en tant que démarche directement issue de la philosophie. Néanmoins, si l'on analyse les problématiques qui l'ont motivée à son origine, on s'aperçoit que cette méthode a été formulée à partir d'une nécessité théorique qui est strictement liée aux exigences de la clinique. Entre les années 1910 et 1920, en effet, le problème qui se pose à Binswanger est celui d'intégrer les exigences du savoir scientifique avec l'historicité, l'individualité des cas se présentant à la clinique psychiatrique. Ce problème a des conséquences très importantes d'un point de vue épistémologique, s'il est vrai que l'exigence de rendre compte « scientifiquement » du singulier à une époque où la psychiatrie ambitionnait au modèle des sciences médicales – pour lequel la recherche de l'objectivité se présentait avant tout comme une bataille contre le subjectif – comporte la nécessité de penser différemment la scientificité du savoir psychiatrique. Le recours de Binswanger à la phénoménologie s'explique donc avec la nécessité de réintégrer les catégories explicatives des phénomènes à l'intérieur des phénomènes eux-mêmes. Il s'agira donc, pour le psychiatre-phénoménologue, de saisir les expressions du comportement à partir de leur « essence », une essence que Binswanger identifie avec la norme ou la structure du fait psychique. Grâce également à l'exemple de la clinique freudienne, selon laquelle l'organisation des vécus devait être saisie à partir de l'expression de ceux-ci sous la forme de leurs « relations de sens », Binswanger formulera à son tour une méthode qui entend partir des

vécus psychiques réels et de leurs connexions afin d'y repérer ces « configurations et principes structuraux » qu'il appellera par la suite les « styles d'existence ». Or, ces « structures » ne subsistent pas indépendamment de l'expérience singulière du cas clinique, et pour autant ne se réduisent pas à la singularité contingente de celui-ci, puisqu'elles en constituent le schéma ordinateur. Cette démarche pour laquelle l'explication du phénomène est immanente à sa description se présenterait donc comme une tentative de constituer une méthodologie psychiatrique où enfin les frontières entre théorie (catégorisation) et clinique s'estompent.

Commentary: Vincent PIDOUX | Université de Lausanne, Switzerland

S027. Cross-cultural transmissions of medical knowledge in premodern Asia

Tue 23 July, 14:10–17:40 • Uni Place 3.205

Symposium organisers:

Pierce SALGUERO | Penn State University / Abington College, United States

Ronit YOELI-TLALIM | Goldsmiths, University of London, United Kingdom

Symposium abstract

It is rarely appreciated how much of the history of Asian medicine in the premodern period hinges on moments of cross-cultural interaction and transnational transmission. This panel explores the rich diversity of these medical encounters and the conditions and contexts of such exchanges.

While our panelists focus on a number of discrete historical instances of exchange, what unites our papers as a cohesive whole is our attention to the unique challenges and opportunities that cross-cultural medical exchange pose to us as historians. We will explore important methodological considerations relating to the processes of transmission and translation, such as: What are the historical conditions under which medical exchange occurs? What power differentials encourage or hinder these processes? How is foreign knowledge assessed, absorbed, or rejected by recipients? What forms of cultural translation accompany medical transmissions? What types of knowledge cross cultures easily and what types are more resistant to translation? What categories of historical analysis are undermined or illuminated by the study of cross-cultural medical exchange?

We believe that the methodological and interpretive questions raised by the analysis of cross-cultural exchange will significantly impact the study of the history of Asian medicine. They challenge the discipline's usual focus on familiar models from the classical Chinese and Ayurvedic traditions, and bring to light the pervasive role of foreign medical knowledge in the shaping of ideas and practices. The goal of our panel is to begin a long-term conversation about these important issues between historians working on the history of transmitted medical knowledge across a wide range of geographical and temporal settings.

S027-A

Tue 23 July, 14:10–15:40 • Uni Place 3.205

Chair: Volker SCHEID | University of Westminster, United Kingdom

Dominik WUJASTYK | University of Vienna, Austria

Bactrian and Chinese references in the *Compendium of Caraka*, with a note on Pramukhas in India

"The Compendium of Caraka" (Skt. Carakasamhitā) is a Sanskrit medical encyclopedia composed over several generations after the time of the Buddha, that probably reached its present form in the third or fourth century CE. This paper explores the significance of the Central Asian and Chinese references made in this work. A related topic concerning medical knowledge in Buddhist monasteries in Bactria is briefly examined: the meaning of "pramukha" (>"Barmakid) in Sanskrit inscriptional sources.

Pierce SALGUERO | Penn State University / Abington College, United States

Is Buddhist medicine the missing link in the global history of medicine?

A massive amount of Buddhist literature was transmitted from India to China during the first millennium CE via the Silk Road and maritime trade routes. Though historians of Chinese medicine have paid little attention to this transmission, in fact, a wide range of Indian medical ideas and practices were embedded in these Buddhist texts. My talk will discuss how these long-forgotten Chinese translations provide a "missing link" between Indo-European and East Asian medical systems, and how this moment of crosscultural exchange challenges some of the prevailing assumptions in the Chinese, Indian, and global histories of medicine.

Ronit YOELI-TLALIM | Goldsmiths, University of London, United Kingdom

Tibeto-Chinese/Sino-Tibetan medicine from Dunhuang

Dunhuang was a Chinese town since Han times. It was briefly ruled by Tibetans (781-848) and subsequently controlled again by Chinese. It is within this context that we find various aspects of Sino-Tibetan culture in Dunhuang. These connections and exchanges, which have been studied in areas such as art, religion and history, are also important in medical interactions. This paper is based on an analysis of the Tibetan medical manuscripts from Dunhuang and will focus on the Tibetan moxibustion manuscripts. The paper will discuss some of the similarities and differences between the Tibetan moxibustion manuscripts from Dunhuang and the Chinese moxibustion texts from Dunhuang. This discussion will raise the following question: What can these texts teach us about exchanges between Tibetan and Chinese medical ideas?

Natalie KÖHLE | Harvard University, United States

On the early development of the concept of phlegm in Chinese medicine and its possible Indic connections

When one peruses medical case histories from the Qing dynasty (1644-1911), one sees constant references to phlegm as both cause and consequence of disease. Phlegm, that is, figures as a central, indispensable concept in the Chinese imagination of the body and its pathologies. Curiously, however, when one goes back to the *Huangdi neijing* 黃帝內經, the earliest and foundational classic of Chinese medicine, phlegm does not appear at all. In the earliest Chinese medical texts there is no notion that would resemble the concept of pathogenic phlegm.

By contrast, phlegm forms one of the basic building of Indic medical thinking. Thus, as the appearance of phlegm in Chinese medical thinking was coeval with the advent of Buddhist translations in China, some scholars have suggested that the development of the concept in China was influenced by ayurvedic notions of phlegm. Chinese medical scholars, however, have long explained the emergence of phlegm

independently of Buddhist influences, as a system-internal development of the body fluid *yin* 飲.

In this paper, I take a fresh look at the possible Indic connections of phlegm in Chinese medicine. I argue that the *earliest* occurrences of phlegm in Chinese medicine developed independent of ayurvedic influences, from the Chinese notion of *yin* 飲. On the other hand, I review the translation terms for phlegm in early Chinese Buddhist translations. On the basis of these terms, I argue for Indic influences in the subsequent development the concept of phlegm during the first few hundred years after its appearance in Chinese medicine. Finally I ask how the phlegm of early Chinese medical text, and the phlegm of early Chinese Buddhist translations come to be associated with each other. To answer this question, I look at the context and the functions of the respective terms in both Ayurveda and Chinese medicine, and suggest that the nexus lies in the digestive and "metabolic" system transformation.

S027-B

Tue 23 July, 16:10–17:40 • Uni Place 3.205

Chair: Dominik WUJASTYK | University of Vienna, Austria

Vivienne Lo | University College London, United Kingdom

How to do a history of the circulation of subtle body practices in Asia?

For many years scholars have speculated about the circulation of 'subtle body' ideas and practices around South and East Asia. Yet while there have been excellent monographs on localised practices, little progress has been made in what is surely a history of multiple exchanges in the ancient and medieval worlds. In recent years, however, there has been an increasing elaboration of the early and early medieval character of Chinese bodily based practices aimed at refining the subtle and healing the physical body. Unfortunately, there is a dearth of good, matching, contemporary historical materials for India and Tibet with some of the earliest surviving Tibetan and Sanskrit manuscripts among the Dunhuang manuscripts of North West China. Academic and political cultures in the different area studies have also hampered communication across linguistic and disciplinary domains in the past, and have been important limiting factors. All this is now changing with more value being placed on transcultural studies and investment in interdisciplinary approaches which demand collaborative studies.

This presentation will draw out the challenges and possibilities that lie in tracking a range of body terms, physiological concepts and practices concerned with the subtle body and chart what can be known about their emergence socially and historically in India, China and Tibet. Implicated in this enquiry will be the structures of the body including the channels and vessels of the body and self cultivation, the essences that flow within and around them, strategic body *loci* and death points in forensic medicine and martial arts. An important factor will also be the temporal constructions that govern physiological time.

The point is not to come to any conclusions, but to contribute to shaping future initiatives. The time is right to outline the historical problems and design new approaches to the question raised therein.

Volker SCHEID | University of Westminster, United Kingdom

From irrigation culture via territorial warfare to proto-immunity: re-imagining the body in late imperial China

It is widely assumed that vessels (經 *jīng*) - known more commonly in the West as meridians - constitute one of the core features of the "Chinese medical body" and that this body remained essentially unchanged from the time of its conception in the early Han until China's encounter with the West. In this paper I will challenge this consensus by exploring changing imaginations of the body in late imperial China

derived from the engagement with the Treatise of Cold Damage 傷寒論. During the Song, the vessels became the central focus through which physicians interpreted a text that only recently had been elevated to the status of an essential classic. From the late Ming physicians in southern China, inspired by the evidential scholarship movement, challenged this conventional interpretation. They argued that in understanding the Treatise the term *jing* had to be understood not as channels but as boundary markers. This, in turn, led them to perceive of illness as a matter of territorial warfare aimed at dispelling external invaders or subduing internal bandits. I will show that this new perception of the body is closely mirrored to China's geographic organization at the time but also shows early influences from the West. This new understanding of the body traveled to Japan, where it became a cornerstone in the re-interpretation of medical practice carried out by physicians associated with the *kohoha* school. In the course of the late nineteenth and early twentieth centuries, these Japanese interpretations were taken up, in turn, by Chinese physicians to align existing conceptions of medicine as territorial warfare with emerging notions of immunity at the heart of which, once more, they placed the Treatise.

Andrew GOBLE | University of Oregon, United States

Conduits and contexts across the east China Sea: the transmission to and reception of medical knowledge in pre-modern Japan

"Conduits and Contexts Across the East China Sea: The Transmission to and Reception of Medical Knowledge in Pre-modern Japan."

This paper will explore a combination of general factors and specific historical circumstances that catalyzed substantial changes in the shape and quality of medical information in two periods of Japan's pre-modern era. Period One covers the late 13th and early 14th centuries; period Two spans the late 15th and early 16th centuries. In each period we also note a shift in the prevailing locus of medical authority from one social group to another.

In Period One we examine the impact on Japanese medicine of access to Song medical writings that was facilitated by the Song print revolution and the parallel growth of non-state trade and religious networks that spanned the East China Sea, and which were integral parts of what we term an emerging East Asian macro-culture. The role of priests and institutions associated with new and emerging Buddhist sects is highlighted. We will also examine the content of new medical knowledge, focusing on medical writings, and on the imported *materia medica* attested in both formulas and in other sources. The focus is on the warrior capital of Kamakura.

In Period Two we examine changes in Japanese medicine in two broad contexts. The first is the Japanese domestic context (focusing on the Kyoto region) of emergence from the fragmentation of civil war, the new phenomenon in Japanese history of urbanization (with its attendant opportunities for enhanced circulation of medical information), and the growth of the new professional group of secular clinical physicians. The second context encompasses a variety of transnational elements: the transmission of a publishing mindset linked to greater Japanese understanding and use of Korean and Chinese print technology; an appreciation of printed medical works by a new group of patrons (warlords eager to establish cultural credentials); and a greater familiarity with and importation of Ming medical works made possible by a combination of an apparent loosening of Ming maritime restrictions and more extensive trading routes. The end result of these dynamics was the establishment of what we now recognize as Japan's early modern *Kanpō* medical culture.

The paper concludes with some thoughts on the broader topic of the transmission of medical knowledge.

Paul BUELL | Charité-Universitätsmedizin Berlin, Germany
Ana G. VALENZUELA-ZAPATA | Charité-Universitätsmedizin Berlin, Germany

Distillation and medicine: an unwritten chapter in the history of medicine and the exchange of ideas

In human history new technologies have often revolutionized society and life. One of them has been distillation. Besides providing society with important and potent beverages, it has also had a major impact on medicine. Specifically, medicines dissolved in alcohol are more easily preserved and become more potent through concentration of active substances and are better available biologically. Medical distillates even when not based upon alcohol, also concentrate active substances and in many cases make them available in new ways. In the present paper we will look at the history of distillation historically focusing on the major exchanges of technologies that have taken place over the last two thousand or more years between West and East, East and West, and how this relates specifically to medicines. The thesis will be advanced that not only was there a free interchange of technology, but also of specific medicines based on distillation and that the era of the Mongol Empire was particularly important in terms of what took place due to the unification of more of the Old World under a single political authority than any other period of history.

S028. Genetics, eugenics and culture: transatlantic perspectives, 1900-2000

Sat 27 July, 09:10–15:40 • Roscoe 1.008

Symposium organisers:

Pim HUIJEN | University of Utrecht, Netherlands

Toine PIETERS | University of Utrecht, Netherlands

Symposium abstract

This symposium will present research on the transatlantic dimensions of genetics, eugenics and the cultural contexts in which they developed in the twentieth century. Contemporary discussions on medical genetics are now and again overshadowed by the "spectre of eugenics," the fear that human genetics will lead us into a new era of control over sexual reproduction and the discrimination of genetically "inferior" people. Past political manifestations of eugenic beliefs have given rise to these fears. Eugenics as an attempt to improve the genetic quality of the human race was informed and vitalized by revolutionary developments in biology, genetics and medicine. These scientific insights seemed to promise a new cure not only for a wide range of diseases but also for social problems. Animated by concerns over the welfare and health of the nation, eugenicists proffered solutions to perceived social ills and presented themselves as being capable of breeding a better nation. As such eugenics was a meeting ground between science, society, and public policy.

However, the dominant focus of historians on racial eugenics and on the seemingly "pseudo-scientific" nature of the eugenics movements has prevented us from better understanding the historical meaning of eugenics and its intricate and contested relationships with the biological sciences, the field of genetics in particular. The social applications of the biological sciences have initiated debates about social differentiation, scientific responsibility, medical ethics, reproductive autonomy, and human rights that resonate until the present day.

Multiple discourses converge around the use and adaptation of genetic knowledge in the workplace, the home, and the wider world. The use and abuse of genetic knowledge both before and after the Second World War has raised pertinent questions about the relation between individual wellbeing and national interest, privacy and state control, and, most pertinently, the body and the body politic:

- How did knowledge-claims travel between these discourses, between countries and communities and how were these knowledge-claims translated into the practices of everyday life?
- To what extent did discourses about heredity, genetics and eugenics follow different trajectories in various European countries and the United States?
- How were genetics and eugenics used to construct categories of differentiation and “othering” such as race, ethnicity, normalcy and gender?

By exploring an interdisciplinary and transatlantic approach this symposium aims to place the popular and pervasive movement of eugenics at the crossroads of fundamental debates about the role of the biological sciences as part of the “modernization project”.

S028-A

Sat 27 July, 09:10–10:40 ▪ Roscoe 1.008

Chair: Toine PIETERS | University of Utrecht, Netherlands

Pim HUIJEN | University of Utrecht, Netherlands

Digital approaches to eugenic thinking in the Netherlands, 1860–1945

Contemporary discussions on medical genetics are often overshadowed by the ‘spectre of eugenics’, the fear that human genetics will lead us into a new era of control over sexual reproduction and the discrimination of ‘genetically inferior’ people. Past political manifestations of eugenic beliefs – of which the eugenic laws in Nazi-Germany obviously have been the horrific summit – have given rise to these fears. However, the dominant focus on racial eugenics blurs the fact that genetic and eugenic thinking have had much more widespread impact on Western culture and societies before the Second World War.

The Netherlands, where the official eugenics-movement has always been fairly marginal, is a good example. “Hard-line” eugenics-supporters were not in the position to monopolize the public discourse. The aim of this paper is to show that did not mean genetic and eugenic thinking was not present in Dutch society. On the contrary, it could spread more through various domains – either latently or explicitly – just because it did not necessarily possess a strong political and racial connotation. This claim is based on an analysis of historical news media. After all, these have been a playing ground for (re-) shaping the meanings of eugenics and human heredity in a broad spectrum of discourses within various contexts. In other words, historical records offer us various scenarios of how societal hopes and fears about genetics may influence public health and social policies.

The project this paper is based on not only aims to contribute to the historiography on eugenic thinking in Western culture. Its goal is also to develop a new data-mining tool for this type of research. After all, historical research on the above mentioned dynamics has been severely hampered by the extraordinary task of manually gathering and processing large sets of opinionated data in news media. In this way, it is, furthermore, almost exclusively possible to take into account documents that explicitly refer to eugenics issues and debates. Digital tools are, in contrast, able to provide information on ideas and notions about heredity, genetics and eugenics that circulate in discourses that are not directly related to eugenics (entertainment, sport and culture). The tool will enable historians in general to collect and process large sets of opinionated text-data from news media and extract discourse identity and intensity patterns.

Heike PETERMANN | Westfälische Wilhelms-Universität Münster, Germany

The case of perfection: eugenic ideas in literature in the Anglo-American countries and Germany

With his talk “Eugenics: its Definition, Scope, and Aims” in 1904, read before the Sociological Society in London the British polymath Francis Galton gave an introduction to his idea of Eugenics. The geneticist William Bateson and also the writer Herbert G. Wells were in the audience. (A) In the late 19th century, mostly influenced by the work of Charles Darwin, eugenic ideas grew and spread widely in scientific and popular literature in the Anglo-American countries and Germany. HG Wells developed in his book *A modern Utopia* (1905) his model of an eugenic state, in the tradition of Plato and Thomas Morus. More important was Aldous Huxley’s *Brave New World* in 1932 (revisited in 1958), who wrote down his ideas of controlling reproduction, social and personal life. At the same time geneticist Hermann J. Muller published his ideas of improving reproduction that became real with in-vitro-fertilisation in the 1970ies. (B) Popular literature on eugenics was pretty important to reach the public since the beginning of the 20th century. Examples are *Science of Eugenics* [...] (in English), first in 1904, and *Die Frau als Hausärztin* (in German), since 1917. Both gave advice for reproduction and named eugenics as an aim. Those publications were mainly addressed to women. (C) In 1931 *Human Heredity*, the English translation of the German book of E. Baur, E. Fischer and F. Lenz *Menschliche Erblichkeitslehre und Rassenhygiene* was published. After World War II the first available handbook on human genetics was translated from English and written by Curt Stern. Conclusions: 1. Popular literature was important for spreading of eugenic ideas widely within population and countries. 2. There was transfer of knowledge by scientific and popular books. 3. No difference was in the meaning and the importance of eugenic measures in Anglo-American countries and in Germany.

Carole McCANN | University of Maryland, Baltimore County, United States

Gender, eugenics, and the population explosion: a case study of transatlantic demographic narratives of the nation

Between the 1930s and 1960s, the field of demography developed in close association with eugenics in the International Union for the Scientific Study of Population Problems, the United Nations Population Division, and the Population Council. Through a genealogy of transatlantic demographic theory and measurement practices, the paper illuminates the eugenic logic inscribed in demographic calculations of ‘natural’ fertility and prescriptions for biomedical interventions to control national population trends in the Global South. The paper argues that demography reaffirmed eugenic gender politics expressed in the singular concepts of the individual/the national interest and the human body/the body politic. It shows that demographic narratives/figures presume an (implicitly masculine) modern individual actor whose reproductive decisions encode market logic into national population dynamics. The other sex, women are merely the biological mediums through whom those reproductive decisions pass, and, therefore female bodily events (e.g. age of menarche, age of first birth, etc) become the objects of demographic measurement practices. Moreover, demographic narratives and population figures simultaneously refurbish eugenic tools for ranking men and nations on the scales of modernity. That is, demographic figures array nations on a progressive scale of improvement (triumph) over natural fertility and mortality trends, thereby making purposive regulation of national population trends a requisite feature of economic modernization. Such measurement practices obscure the gendered social relations of reproduction with naturalized scripts. Thus, pregnancy risk is calibrated to ovulation rather than intercourse, foreclosing scrutiny of the heterosexual practices, or any gender-based conflicts within them. Likewise, the demographic scales of modernity reinvigorate imperial eugenic regulatory scripts in their contrast of restrained modern (European) men, reflected in lower fertility rates, with unrestrained brutes of lesser nations, whose high fertility rates reflect disregard for women and economic backwardness.

Dirk THOMASCHKE | Carl von Ossietzky Universität Oldenburg, Germany

‘A stable and easily traced group of subjects has become more difficult than ever’: human genetics and space in Denmark and the USA around 1945-1960

The history of human genetics and eugenics in Denmark in the second half of the 20th century has hardly been examined so far. Nevertheless Danish research and eugenic practices were well known and admired throughout the academic world from its foundation in the late 1930s till the 1960s, especially for its nation-wide, comprehensive registry of genetic diseases. The proposed paper compares the development of human genetics and eugenics in the USA and Denmark in the 1940s and 1950s. The focus lies on spatial concepts in the discourse on human genetics. The paper draws mainly on archival sources from Denmark: personal papers of leading scholars and research institutes in the field of human genetics. In 1938 the institute of human genetics and eugenics was founded at the University of Copenhagen with a generous grant from the Rockefeller Foundation. One of its most important goals was to establish a nation-wide registry of all patients with hereditary diseases and their family members. It ought to support the application of eugenic sterilization and abortion according to the Danish law. At the same time such a registry was the primary means of research in human genetics up to the late 1950s and strongly desired in other countries as the United States, too. It seemed especially valuable when installed in a “Western”, “civilized” country such as Denmark: the Danish population was considered relatively homogenous and well filed in health and welfare systems at the same time. The main promise was to “follow and control” the “rate of mutations” in modern human populations exposed to technological and societal progress – including the pressing question of the genetic effects of nuclear irradiation. The paper argues that populations were constructed as relatively hermetic “genetic containers” by these research practices.

S028-B

Sat 27 July, 11:10–12:40 ▪ Roscoe 1.008

Chair: Pim HUIJNEN | University of Utrecht, Netherlands

Hannah MACGREGOR | University of Ottawa, Canada

The cultural, scientific and political applications of eugenics in the United States, 1890-1940

Based on primary government sources and cultural documents, this paper explores the American eugenics movement as an exemplary model of progressive reform from 1890 to 1940. Other progressive reforms met with mixed success due to opposing goals and moral beliefs within similarly interested groups. However, American eugenicists introduced a single, coherent message concerning a new biological vision for an improved society and disseminated it through popular cultural mediums, making eugenics a socially identifiable and effective tool for the agendas of numerous reforms. As a scientifically based movement that seamlessly converged with the American cultural debate on the preservation of national character, eugenic principles animated several prominent reform projects. Furthermore, scientific and social ideas were popularized at national, state and local levels, sustaining long-term legislative and judicial success. Eugenics became a means of gaining practical and legislative results and was a prominent method of social engineering. For instance, sexual immorality was denounced by the anti-prostitution movement, the concept of a biologically fit and capable nation pleased American imperialists, and the declaration of alcoholism as an undesirable trait interested the prohibition lobby. Organized labour supported restrictive immigration policies based on eugenic arguments, concerned with immigrants affecting wages. Eugenics can be seen as a method of understanding American culture and psyche in the first half of the twentieth century.

Patrick T. MERRICKS | Oxford Brookes University, United Kingdom

Problem families and eugenics in British society, 1900s-1950s

Since its introduction in 1943, the term “problem families” has been used to classify a relatively small sector of society assumed to cause problems disproportionate to its size. This paper examines a project conducted by the British Eugenics Society that attempted to address this very issue, culminating with the Problem Families Committee (1947-1952). A key aspect of this study involves exploring the interaction between eugenic ideology and the porous border that loosely segregated “nature” and “nurture” interpretations of human society. With this in mind, I examine: first, the rise of the term “mental deficiency” and its attempted use by eugenicists to explain the existence of the poor in the inter-war period; second, the emergence of “Problem Families” as a typological sub-section of society, in some respects considered hereditarily degenerative but, significantly, also a product of the inequalities of modern, urban society; and finally, I draw tentative conclusions on why the term “problem families” still resonates in popular and political discussion today. I operate here on the premise that the “problem families” discourse was characterised both by a ubiquitous struggle to define the “problem family” and a wider metaphysical struggle concerning the nature of heredity and what it meant to be human.

Toine PIETERS | University of Utrecht, Netherlands

Aldred Scott Warthin’s family ‘G’: the American plot against cancer and heredity (1895-1950)

Cancer is according to many a most promising test case of the new ‘genetic medicine’ of the 21st century. However new in terms of the genetic technology used it is important to realize that taking into account genetic or hereditary factors in cancer medicine is nothing new in itself. Since at least the eighteenth century medical doctors and patients have tried to establish links between heredity and cancer. In 1913 the Michigan University pathologist Aldred Scott Warthin published his first study on a family with a so-called ‘inherited susceptibility’ to cancer. The susceptibility in this family ‘G’ was associated with the risk of creating an “inferior stock”. Given the boost of studies on heredity and disease, and the vogue for eugenics at the beginning of the twentieth century one would expect strong support for Warthin’s study. If not for purely scientific reasons Family G might have been picked up as part of the gospel of eugenics; an exemplary case of a degenerative stock to be used as an exhibit of eugenics. After all, Warthin was a rising star within the American medical establishment and had become part of John Kellogg’s eugenic priesthood in Michigan. However, none of these likely scenarios did materialize. I will show in this paper how the cancer idiom of heredity that was associated with shame, fatalism and stigmatization became regarded by the powerful American Society for the Control of Cancer as counterproductive in the fight against cancer and was blotted out.

Susanne DOETZ | Charité-Universitätsmedizin Berlin, Germany

Establishing genetic counselling in the GDR

Against the background of the national socialist past and Lysenko’s doctrine, human genetics research in the GDR was practiced on a limited scale until the late 1960s. The doctrine of Lysenko which had been transferred from the Soviet Union proclaimed the inheritance of acquired characteristics as reality and denounced genetics as pseudoscience. Under the scope of the so-called Biologieprognose (biology prognosis) in 1966, GDR scientists maintained the need for investigation into human genetics. In the process, they stressed the progressive international development in that field. Five years later (1971) the project human genetics started. Its previous goal was the establishment of a genetic counselling family service. In the midst of the 1980s, genetic counselling helpdesks were available in each district

(Bezirk) of the GDR Therefore genetic counselling served as a means of transmitting and applying modern molecular genetic knowledge. The main question I would like to raise is: How could a method like genetic counselling, which was marginal and considered to be the applied practice of a historically-loaded branch of science, be constituted in a state which in order to distinguish itself from the Federal Republic of Germany had to distance itself vehemently from any biologicistic attitudes. Under which terms was this change of mind justified? Inter alia, drawing upon the publication human genetics in a socialist society by the Institute of Marxism-Leninism of the Medical Academy in Magdeburg (GDR), which had the duty to investigate the relevance of human genetic measures under socialism, I would like to outline the conception of human genetics in a socialist society and the recommendations derived from it, such as advice on how to perform genetic counselling responsibly or how to deal with genetically-related contraception or abortion.

S028-C

Sat 27 July, 14:10–15:40 ▪ Roscoe 1.008

Chairs:

Lynn ROSE | Truman State University, United States

Chris GOODEY | Independent scholar, United Kingdom

Nicole K. KONOPKA | Bamberg University, Germany

Engineering perfection in Kirsten Bakis' *Lives of the Monster Dogs*

"The image of man betrays that which distinguishes him from all other beings: his ability to observe himself. It is men's fate that he not only rejoices in what he sees, but is displeased by his faults, physical and mental. Men's urge to civilize compels him to strive for the improvement not only of his material conditions, but of himself as well. To prune and to cultivate. The image of man bears witness to this ambition." These opening lines of *Homo Sapiens 1900*, a 1998 documentary by Peter Cohen, highlight how the film deals with various eugenic methods throughout the 20th century, focusing primarily on four national contexts (USA, Sweden, Russia and Germany) to illustrate the development of "race research" and the disastrous results of human intervention into natural proceedings. These lines also apply to Kirsten Bakis' novel, albeit on "dog scale": In *Lives of the Monster Dogs*, the canine voices in the narrative are displeased; it's dogs who are pruned and cultivated to their creator's measures of perfection. The novel is a fictional account of a Frankensteinian experiment that begins in rural Switzerland, is refined by the patronage of a king of Prussia (ironically enough, the Kaiser Wilhelm Institute in Berlin was the home to "hereditary research"), eventually is taken into the Canadian wilderness, and comes to a furious conclusion in a magnificent building called 'Neuhundstein' in New York in 2009. Kirsten Bakis' text deals with many issues that this symposium touches upon: the control of natural selection/eugenics, politics of the body as politics of dispossession and enslavement, the role and responsibilities of archivists and archives, the scientist as equally talented and terrifying etc. In my paper I will show just how much this novel is infused with ideas of racial hygiene, the manufacturing of perfection and the many selective processes – one of them migration – that are used in order to achieve this goal. Rich material provided by literary scholarship on animals as protagonists and narrators (as well as metaphors) provides the theoretical framework; I draw also on Nell Irvin Painter's *The History of White People* (2010). The novel is as much an observation on the "breeding" of celebrities as it is an illustration of ambition and scientific, scholarly, and individual excess.

Andrea ZITTLAU | University of Rostock, Germany

Painted black: eugenics and the issue of race in a transatlantic Perspective

Toni Morrison's latest novel, *Home* (2012) is a story about the Korean-war veteran Frank Money who escapes an insane asylum to travel

across a deeply prejudiced America into his past. While the narrative unravels his scars, he is on the mission to rescue his sister Ycidra from the generous physician she works for. Employed as a "helper" ("You mean like a nurse?" "No. A helper. I don't know." 57-58), Cree becomes the doctor's experiment to improve gynecological surgery while at the same time working on techniques of abortion in a much larger eugenics project. As Daylanne English and Susan Schweik have revealed in their latest books (*Unnatural Selections* 2004, *The Ugly Laws* 2009), eugenics fundamentally shaped public policy and aesthetic theory in late nineteenth and early twentieth-century America. While immigrants formed an open target for racist thoughts, the pathologizing of the black body had long prepared a much more implicit category of discrimination disguised as salvage medical humanist thought. My paper will take its departure from Toni Morrison's novel to investigate the process of pathologizing the black body to eagerly include it into eugenic discourses. Propaganda films such as the *Black Stork* were in direct dialogue and response to German products of intense political and scientific communication and can only be discussed in the awareness of a transatlantic connection.

Lynn ROSE | Truman State University, United States

Chris GOODEY | Independent scholar, United Kingdom

Summary and discussion: Internationalism, Americanism, pan-eugenics, and Harry Laughlin's campaign to promote multilateral arrangements for the control of international migration

This slot will include discussion of a precirculated paper by Jason McDonald.

Commentary: Murray SIMPSON | University of Dundee, United Kingdom

S029. Visual, material and empirical culture in early-modern Iberian science: artifacts, regiments, vessels, nautical charts, natural specimens, cosmographers, naturalist and pilots

Wed 24 July, 09:00–12:30 ▪ Roscoe 1.007

Symposium organisers:

Emma SALLEN DEL COLOMBO | Universitat de Barcelona, Spain

Antonio SÁNCHEZ | Centro Interuniversitário de História das Ciências e da Tecnologia, Portugal

Symposium abstract

The main objective of this symposium on Iberian science in the Early Modern world is to highlight through individual case studies the scientific contribution of the Iberian societies during fifteenth, sixteenth and seventeenth century that allow us a better and more complete understanding of the history of early modern science. This contribution has some peculiarities not found elsewhere or at another time, such as geographical expansion and the trade relations and technological innovations that were developed for this. These aspects are features of the Iberian expansionist empires developed on a scale impossible to run during the Middle Age.

These global ventures were based in peripheral sciences as nautical astronomy, cosmography, natural history, cartography or navigation, empirical practices on which Portugal and Spain raised their Catholic empires, shaped the new *imago mundi*, established shipping routes to the East and West, stimulated the creation of new transoceanic economies, created new validation mechanism of scientific knowledge, and mobilized a new form of organization of this knowledge in modernity.

The singularity of the so-called Iberian Science in the Age of Discovery and expansion took place in centers of power and knowledge situated between the Mediterranean and Atlantic -in Seville, Lisbon and Madrid-, and was based in institutions or centers of knowledge production - specific mapping workshops, schools of navigation or academies of mathematics-, artifacts or technological support that facilitated the domination and maintenance of the colonial territories -vessels, astrolabes, nautical charts, regiments or other scientific treatises- jobs, occupation or scientific positions -mapmakers, engravers, astronomers, makers of nautical instruments, cosmographers, pilots or naturalist-, and the publication of books in vernacular language that would become very important for competing powers. In this context, we should say that Iberian science was an activity sponsored by the State and it was developed around 'intermediate figures', especially cosmographers.

In short, the new theoretical approaches that we have today at our disposal, from studies of visual and material culture of science, allow us to rethink what was the role played by Portuguese and Spanish artisans in the broader context of the early modern science. The documentary sources of the Iberian world are real testimonials about how, where and under what conditions scientific knowledge was produced in the preliminary stages of the early revolution of the European sciences.

S029-A

Wed 24 July, 09:00–10:30 ▪ Roscoe 1.007

Chair: José Ramón MARCAIDA | University of Cambridge, United Kingdom

Tayra M.C. LANUZA-NAVARRO | CSIC-Universitat de València, Spain

Adapting traditional ideas to the new reality: cosmographers, physicians and the need for a renovated astrology to describe the New World

The geographical discoveries forced some disciplines to adapt to the new realities. Among the disciplines that underwent a shock and a great change due to the new territories, natural history has been a traditional example. But other traditional disciplines in which cosmographers had an interest experienced a similar process. Astrology, a classical knowledge that was continued to be practiced, studied and taught at several institutions of knowledge in the early modern Hispanic monarchy, including probably the Casa de Contratación, was in a position comparable to that of natural history. It also had to adapt to the new reality, to that new world that had not been taken into account in the ancient descriptions of the astrological nature of places and men. Cosmographers, along with physicians and more or less professional astrologers, tried to fit the new territories in the traditional astrological chorography and establish the astral influences that would determinate meteorological phenomena, health and the general complexion and temperament of the inhabitants of the New Spain. All in the middle of the discussions on renovation needed for disciplines, particularly, in the middle of the debate about astrology. The aim of this paper is to consider the way these cosmographers and physicians adapted their astrological chorographical ideas to the tradition of the discipline.

Antonio SÁNCHEZ | Centro Interuniversitário de História das Ciências e da Tecnologia, Portugal

The standardization of the Portuguese cosmography in the sixteenth-century: the

Regimento do Cosmógrafo-Mor (1592), the *padrões d'el-Rei* and the figure of *Cosmógrafo-Mor*

In line with the studies on early modern Portuguese cosmography and navigation initiated by authors like Reijer Hooykaas and John Law, and under the growing historiographical interest aroused by recent studies on the Iberian world, this presentation is devoted to the study of three elements: a text (the *Regimento do Cosmógrafo-Mor* or the *Regiment of the Cosmographer Major*), a map (the *padrões d'el-Rei* or royal pattern charts) and a scientific post (the *Cosmógrafo-Mor* or *Cosmographer Major*). These three elements are crucial to understand the attempts of the Portuguese crown to carry out the standardization of cosmography as a science in the service of the interests of the empire.

First, the *Regiment do Cosmógrafo-Mor* of 1592 is a treaty with a series of statements that attempted to regulate the Portuguese navigation and cartography in the sixteenth century, in general, and nautical astronomy, making charts and nautical instruments and nautical teaching in particular. This textual document is an unprecedented testimony of organizational, technical and educational conditions of the Age of Discovery. Secondly, the *padrões d'el-Rei* were cartographic models used by the chartmakers in the *Armazéns da Guiné e Índia* of Lisbon to make copies for pilots. And third, the *Cosmógrafo-Mor* was the highest official scientific position of the sixteenth century and was the person in charge of transmitting new cosmographical knowledge and nautical techniques to her students, to correct the nautical regiments and to introduce the progressive developments of overseas exploration in the cartographical patterns.

The comparison between the *Regimento do Cosmógrafo-Mor*, the cartographic *padrões d'el-Rei* and the figure of *Cosmógrafo-Mor* with other elements from the Spanish cosmography of the same era such as the instructions for the formation of the *Relaciones Geográficas de Indias*, the *Padrón Real* (Master sea-chart) of the *Casa de la Contratación* (House of Trade) in Seville or the scientific post of *Piloto Mayor* (Pilot Major) offers us new meanings of why cosmography, along with navigation, was systematically regulated and controlled by the Iberian crowns throughout the sixteenth century.

Jana ČERNÁ | University of West Bohemia, Czech Republic

Iberian science, the discovery of the New World and early-modern Czech lands

The aim of this paper is to analyze the reception of Spanish Renaissance sources containing knowledge about nature in the New World in the Czech Lands in the 16th and the beginning of the 17th century. Attention will be paid to Czech herbariums, cosmographical works and travel reports (e.g. Tadeáš Hájek, Sigismund of Püchov, Daniel Adam of Veleslavín or Adam Zalužanský of Zalužany), which provide information about products of nature of the New World, for example, based on the knowledge of works of C. Columbus, Mártir de Anghiera, N. Monardes or José de Acosta. The space of Czech castle libraries and cabinets of curiosities (especially the important Czech Renaissance dynasty of the Rosenbergs), which give evidence of the interest in Spanish Renaissance science and knowledge about the New World, will also be mapped. Based on the analysis of selected representative texts, illustrations and material objects (scientific or artistic), this paper will show the culturally contextual dependence and specificity of interpretation of Iberian natural-science knowledge about the New World in the Central European area.

S029-B

Wed 24 July, 11:00–12:30 ▪ Roscoe 1.007

Chairs:

Emma SALLEN DEL COLOMBO | Universitat de Barcelona, Spain

Antonio SÁNCHEZ | Centro Interuniversitário de História das Ciências e da Tecnologia, Portugal

Emma SALLET DEL COLOMBO | Universitat de Barcelona, Spain

Natural history illustrations between Bologna and Valencia: the Aldrovandi-Pomar case study

As some researchers pointed out, Ulisse Aldrovandi's *tavole acquarellate* and the *Atlas de Historia Natural* (known as *Códice Pomar*, offered by Felipe II of Spain to the physician Jaume Honorat Pomar from Valencia), share a number of almost identical visual representations of animals and plants. A close analysis confirms that is the case for more than one hundred illustrations from the two collections. We present some working hypothesis in order to try to understand this *coincidence* and contribute to the comprehension of the mechanisms of circulation of knowledge between Italy and Spain in the second half of XVI century.

Luana GIURGEVICH | Centro Interuniversitário de História das Ciências e da Tecnologia, Portugal

Scientific books and reading practices in early-modern Portuguese religious houses

Much has already been written about the relationship between science and religion. In the Iberian context, however, religious houses, viewed as an important site for fostering scientific practices, are a topic that still requires closer scrutiny. The main purpose of this paper is to show the importance of the Portuguese religious houses in the context of Iberian Science in Early Modern world, through the study of former religious libraries and their scientific content. In Portugal's archives and libraries, the number of scientific books with inscriptions of provenance from former religious libraries is impressive. This paper tries to show that the religious houses were not just the most important repository of scientific books in Portugal, but also a site of scientific activity. This paper is part of a larger current research project on the acquisition and circulation of scientific books in Portugal in the 15th-18th centuries. This project attempts to reconstruct the scientific collections of the former monastic libraries on the basis of their historical catalogues. These huge collections were totally dispersed after the waves of secularisation of the 18th-19th centuries. By exploring the extant library catalogues and inventories of the major religious orders it is possible to identify a rich corpus of texts which enlightens the diffusion and the impact of scientific books in Portugal. Library catalogues provide an essential source of information, but an examination of the exemplars is also necessary to reconstruct reading practices. The fruition of scientific books in religious context is considered also in an effort to stress its importance in relation to the scientific practices of each of the different Portuguese religious congregations.

José Ramón MARCAIDA | University of Cambridge, United Kingdom

A palace with empty walls: Juan Eusebio Nieremberg's *Historia naturae* and the visual culture of science in early modern Spain

Focusing on the capital city of Madrid during the first half of the seventeenth-century, this paper explores early modern concerns regarding the visual aspects of natural knowledge in the context of the remarkable expansion of the arts in Golden Age Spain.

In particular, it studies the production of an important contribution to early modern natural history, Juan Eusebio Nieremberg's *Historia Naturae* (1635), against a backdrop of significant investment and dedicated patronage of the visual arts, most notably painting, in seventeenth-century Madrid.

S030. Is it the medium? Ways of communicating science in twentieth-century Europe

Fri 26 July, 14:00–17:30 • Roscoe 1.009

Symposium organisers:

Jean-Baptiste GOUYON | Science Museum, London, United Kingdom

Arne SCHIRRMACHER | Humboldt-Universität zu Berlin, Germany

Symposium abstract

In line with the practical turn in the history of science, studies in the history of the communication of science concentrate on the actors and processes of the popularisation of science, i.e. the various media through which scientific knowledge is made public. These studies span a field that goes from analysis of science journalism through to discussions of fictional cinema's role for the public communication of technoscientific knowledge. They emphasise the interactive and multidirectional ways in which science is communicated.

However, in contrast with the plurality of sites and means by which technoscientific knowledge is made public, it appears that although some prominent figures of science were present in all media during the 20th century, the producers of the regular fare of popular science -- in print, on air, on screen, on stage or in the museum -- seem to have been very much restricted to their single area. For example, David Attenborough who published some popular natural history books made his name as a British television figure and remained, throughout his career, very much associated to natural history television programme-making. By contrast Gerald Durrell, first known to the British public as an author of popular natural history books, remained associated with the printed medium despite a venture in natural history television. Other lines of fractures can be located at the institutional level. For instance, in postwar Germany science was broadcast along rather different political lines whether it was on television or radio, the former adopting a conservative attitude and the latter a more progressive one.

The proposed symposium will endeavour to consider this issue and ask whether the way knowledge is put at work to produce popular science is constrained by the medium in which this occurs, the audiences that are addressed, or the genre that is produced. The papers in the symposium will aim at characterising the triangular relationship between media qualities, the sociology of both media producers and their audiences, and genres of popular science. The range of speakers will allow for the development of a comparative approach at the European level, with case studies from e. g. Britain, France, Germany, Poland, Spain, Denmark and the Netherlands.

S030-A. Print, radio, news-reel

Fri 26 July, 14:00–15:30 • Roscoe 1.009

Chair: Jean-Baptiste GOUYON | Science Museum, London, United Kingdom

Kristian H. NIELSEN | Aarhus University, Denmark

Science journalism in the twentieth century: exploring the boundaries between science news, science advocacy and fourth-estate science journalism

Science journalism is a specialized genre of communicating science, adhering to more or less formalized practices of journalism and often (but not always) reporting science as news. By the turn of the 19th

century, various forms of science writing, including science writing for newsprint and popular magazines, were well established. With the institutionalisation of modern journalism in the course of the late 19th and early 20th century, including professional societies, schools of journalism and the rise of mass media, some science writers began contemplating a new professional identity as science journalists and a new genre of science writing, namely science journalism.

This paper traces the evolution of science journalism in the course of 20th century. Seeing science journalists as quintessential boundary workers who are charged with reporting science on the boundary between science and the public, the paper identifies three ideal genres or repertoires for science journalists: “science news”, selecting events in science that conform to (more or less explicit) norms of news journalism; “science advocacy”, promoting the value of science to the public; and “fourth estate science journalism”, critically investigating the role of science in society. The three genres of science journalism each assign a different role to the science journalist on the boundary between science and the public, but also have implications for the rhetorical and narratives codes of science. Looking at a few selected case studies from United Kingdom, Germany, and Denmark from the early to the late 20th century, it will be argued that there is no simple historical progression from one genre to another. Rather, the three genres enable, but also constrain the ways in which scientific knowledge travels from the domain of scientific communication to the realm of public discourse.

Ralph DESMARAIS | Imperial College London, United Kingdom

The BBC, British scientific intellectuals and the early atomic era

An older historiography, heavily dependent on British scientific intellectuals' published works and their political involvement in scientific organisations, maintained that the well-known British social-relations-of-science movement of the 1930s and early 1940s had been effectively curtailed by the onset of the cold war. This paper argues that a very different picture emerges when the BBC's substantial early postwar science-related programming is taken into account. In the wake of Hiroshima and amidst East-West ideological rivalry, BBC radio was arguably the principal medium through which the British public (and overseas listeners) became exposed to competing scientific intellectuals' views concerning the place of science in the early atomic era. Scientific intellectuals, often speaking alongside contemporaries from other disciplines, discussed and debated crucial issues in ways not appearing in the print media. Their importance became even more pronounced with the 1946 inauguration of BBC radio's elite Third Programme, whose remit was to 'be of the highest possible cultural level, devoted to...serious documentary, educational broadcasting, and the deeper investigation of the news.'

Three particularly salient strands of BBC radio science are addressed in this paper. Firstly, amongst the 120 radio talks' and discussion programmes concerning atomic energy in this period were many which transcended factual content and reflected speakers' personal views and beliefs. Important examples of the latter include a sharp exchange in 1948 between the British atomic physicist P.M.S. Blackett and the U.S. representative to the UNAEC, concerning Blackett's highly-controversial opposition to Western atomic energy control policy; and Bertrand Russell's famous 1954 'Man's Peril' talk which sparked the Campaign for Nuclear Disarmament. Secondly, are key debates between scientific intellectuals on rival cold war ideologies; these include J.D. Bernal versus Michael Polanyi on Soviet scientific planning, and J.B.S. Haldane versus C.D. Darlington on the political ramifications of Lysenkoism. A final strand concerns BBC programmes which addressed cold war issues obliquely; a particularly illuminating example is the 1948 epic series 'Ideas and Beliefs of the Victorians' where historians of science and scientific popularisers invoked, not Victorian, but contemporary liberal intellectual values, acting as counterweights to their leftist colleagues' influence. Also taken up in this category are programme

series like the immensely-popular 'Brains Trust', which helped secure the postwar fame of British science popularisers like Jacob Bronowski.

Arne SCHIRRMACHER | Humboldt-Universität zu Berlin, Germany

Looking west and looking east? Science broadcasting in the two German states in the 1950s

When after World War II two German states came into being, both started out with rather identical media systems and audience expectations, while context and content quickly became defined by influences of the Cold War. In order to assess to what extent formats and genres of science communication and their reliance on specific media qualities were prone to political shaping, in particular concerning the more or less implicit messages science broadcasts should communicate, the paper compares a number of programmes and programme series both from radio and television. Science on the radio, on the one hand, was a fully established part of German broadcast culture, which had developed to high levels already in the middle of the 1920s with a huge educational agenda. After the war, this well-tried machinery became the means of some battles of programmes between radio stations, e.g. of West and East Berlin, presenting almost simultaneously two series of talks on atomic energy and peace. Television, on the other hand, was in the early 1950s just about to start, thus no common preconditions existed; nonetheless, German television and with it science broadcasts emerged in a way of mutual observance. In the case of television, the growing divergence of the uses of the specific media qualities with respect to science communication by East and West-German broadcasters can be exhibited in two examples. The West-German 'television professor' Heinz Haber, who had learned his trade with Walt Disney in the US, developed a rather unique West-German approach, while with the society URANIA, which became the central institution for popular science in East Germany and which copied various elements of similar Soviet organizations, socialist interpretations of the aims of popular science led to different uses of the qualities of the medium.

Felipe E. RAMÍREZ MARTÍNEZ | Universidad Autónoma de Madrid, Spain

Science, entertainment and propaganda. Did the Franco regime develop a public image of science through the NO-DO newsreel (1945-1964)?

The NO-DO, the official newsreel of the Francoism, was during twenty five years a monopoly on information in the mass media. One of the most unexplored and yet unravelled aspects relate with the central role that NO-DO had in the broadcasting of scientific news and technical advances. The scientific point of view offered by NO-DO definitely contributed to elaborate a common opinion and belief in the Spaniard public during that period of time.

The legitimisation of the regime relied on the achievement of the objectives laid down by the new regime. The absence of any external influence of all either alternative or critical sources to gain access to alternative of understanding the world was a mandatory objective. The compulsory nature of the NO-DO and its monopoly on information facilitated the achieving of these objectives to perfection. The only audio-visual information available to the majority of Spaniards until the ending sixties (when the television became a mass media in Spain) was filtered by the State. A similar treat was also exerted to the scientific and technological topics as anticipated.

NO-DO never developed a specific schedule for spreading scientific and technological subjects, although these topics were always included in the newsreels along the world. These news were used for passing on to the audience the entertainment, the escape and the curiosity expected from the actualities cinematographic genre.

But eventually, the Francoist regime also used this resort in the NO-DO as an outstanding instrument among all its propaganda contents. We hold that for Franco, social and economical progress were directly associated with technology and science. The official speech consisted of insistently repeated instructions and slogans shown weekly on the screens. Every week the Spanish people could watch the progress of the New Spain in the monotonous and repeated scenes made with the same characters, the same settings and the same plots.

Science and technology were always present in the reports and they played an important part in the creation of a Spanish reality which didn't always have to do with the harsh and difficult real life.

On the basis of a survey of more than 2,000 news releases screened by NO-DO concerning scientific and technological issues, I will argue that NO-DO used the news related with science and technology in two different and complementary ways: helping Spaniards to escape from their reality and legitimizing the Franco's regime.

S030-B. Exhibition, museum, TV

Fri 26 July, 16:00–17:30 • Roscoe 1.009

Chair: Arne SCHIRRMACHER | Humboldt-Universität zu Berlin, Germany

Catherine JOLIVETTE | Missouri State University, United States

Displays of power: telling the story of British nuclear physics at the 1951 Festival of Britain

In 1951 the Nobel Prize in Physics was awarded jointly to nuclear scientists John Cockcroft and Ernest Walton. The laureates were honored for their research on the transmutations of atomic nuclei, having successfully conducted the first controlled artificial disintegration of elements at the Cavendish laboratory in Cambridge in 1932 under the direction of the pioneering physicist Ernest Rutherford. In the same year that Cockcroft and Walton received the Nobel Prize in Physics their groundbreaking achievements, along with those of numerous other notable Britons, were honored in the Festival of Britain; a summer-long, nation-wide calendar of events and exhibitions that ran from May through September.

Within the nationwide programme of Festival events there were multiple exhibitions that showcased nuclear science: in London these included the *Exhibition of Science* at the Science Museum in South Kensington, a display on nuclear physics as part of the *Physical World* section of the *Dome of Discovery* at the *South Bank Exhibition*, and the *Growth and Form* exhibition at the Institute of Contemporary Arts; while in Scotland Glasgow's Kelvin Hall played host to the *Exhibition of Industrial Power*.

In telling the story of British nuclear physics at the Festival of Britain, visual displays played a key role. In this paper, exhibits and works of art from various Festival sites are examined in terms of the discourses that they engaged concerning both the potential—for better or for worse—of nuclear energy, and the impact of the atom on both the artistic output and popular imagination of the era. In dialogue with the conference theme of 'knowledge at work,' this paper explores the contributions of artists and designers in communicating scientific discoveries to the public through the conduit of the national exhibition.

The positive presentation of nuclear physics, underscored by Festival narratives contributed by figures such as Jacob Bronowski, is read against more anxious concerns about nuclear capabilities that were conveyed in works by some of the commissioned artists. Artworks and exhibits considered include designs by the Festival Pattern Group; John Tunnard's crystallographic mural for the South Bank's *Regatta Restaurant*; Richard Hamilton's installation at the ICA; Laurence Scarfe's *Atomic Energy* mural in the *Dome of Discovery*; and William Crosbie's atomic mural for Glasgow's *Hall of the Future*.

Jean-Baptiste GUYON | Science Museum, London, United Kingdom

Visual displays of space conquest at the Science Museum and on television in the 1960s

A comparison of displays of science and technology at the science museum and in television programmes in the 1950s and 1960s indicates that both media relied on categories related to everyday life to organise their displays and make science and technology part of their audiences' daily existence. However, this community of outcome should not obscure the fact that each medium displayed science and technology according to specific conventions.

From this vantage point, the specific example of the display of space conquest in the sixties in both media opens up interesting perspectives. The topic of space conquest was a new one in the sixties, insofar as space conquest started in earnest at that very moment, and it dominated science communication for the period. Further, when it comes to television and the museum, the sixties was a period of definition or re-definition, respectively, for both media in terms of conventions of display.

This paper considers the evolution of displays of space conquest both at the Science Museum in London and in BBC television science programmes during the sixties. Examining how the two media appropriated the topic, and in doing so fashioned their language of visual display in distinctive ways, it argues that each medium can be said to have become more articulated about the topic as time went on.

Whilst the science museum shifted away from an aesthetic of accumulation towards one of sobriety and showmanship, television science distanced itself from the culture of radio broadcasting in favour of the conventions of film-making and increasingly forwarded the intimacy that the motion picture camera can procure as a way of knowing.

Andree BERGERON | Ecole des Hautes Etudes en Sciences Sociales, France

To inform, educate, entertain: French television's *Service de la recherche*, 1960-1974

In 1960, a new service was created within the French public broadcasting service, the *Service de la recherche* (Research service). The structure was in fact not entirely new since it was largely the product of the merging and expansion of two existing structures: the *Club d'essai* (test club) and the *Groupe de Recherche Musicale* (GRM, musical research group). The head of the new structure was none other but the founder of these two bodies, Pierre Schaeffer.

A multitalented character, Pierre Schaeffer is worldwide known for his seminal contribution to concrete music (a denomination he eventually rejected) but he was also a great administrator and an engineer. From 1964 to its disappearance in 1974 in connection with the split up of the public broadcasting office (ORTF), the *Service de la recherche* produced programs fitting the ORTF motto: to inform, educate, and entertain. The "Research Magazine", better known as *Un certain regard* series, was one of the most important space for exposure of science on television in the late sixties and early seventies.

My talk will focus on some characteristics of the *Service* and its members that help explain how, why and which sciences were presented in the *Service's* production.

Carlos TABERNO | Universitat Autònoma de Barcelona, Spain

Félix Rodríguez de la Fuente's broadcasting of nature and the natural sciences: a multidimensional, cross-platform endeavor in 1960s and 1970s Spain

Félix Rodríguez de la Fuente (1928-1980) is a key figure in the history of the natural sciences in 20th century Spain. Although a physician by

trade, he devoted his life to his passion for nature. In addition, he articulated his work as a naturalist and conservationist through an enormous media output. Ultimately, such an effort made him a staple of the media landscape and a highly charismatic character in the complex socio-political scene of the changeover from Franco's dictatorship to the democratic administration in 1960s and 1970s Spain.

By way of his ability, but also, as well, a rather skillful navigation of politics and institutions, Rodríguez de la Fuente became an extremely successful radio and television producer and director, as well as author and editor. His views of nature and the natural sciences were conveyed through the joint use of a number of platforms, television, radio and the printed medium, and the thorough exploration and exploitation of their educational, entertainment and creative possibilities. As a result, he conveyed a highly influential and often controversial representation of nature and the natural sciences through a carefully crafted and highly complex media cross-platform endeavor.

S031. The contribution of Friedrich Engels in the history of science and technology

Wed 24 July, 09:00–12:30 ▪ Uni Place 4.213

Symposium organisers:

Robert HALLEUX | University of Liège, Belgium

Kostas SKORDOULIS | National and Kapodistrian University of Athens, Greece

Symposium abstract

Friedrich Engels (1820-1895) spent two periods of his life in Manchester (1842-1844 and 1849-1869). In 1842, Engels was sent by his parents to Manchester to work for the Ermen and Engels' Victoria Mill in Weaste which made sewing threads. In Manchester Engels wrote his first economic work, 'Outline of a Critique of Political Economy' (1843).

While observing the slums of Manchester, Engels took notes on child labor, the despoiled environment and overworked and impoverished laborers and sent a series of articles to Marx, chronicling the conditions amongst the working class in Manchester. These he would later collect and publish in his influential first book, *The Condition of the Working Class in England* (1845). In this book, Engels described in detail the machinery used in the industrial plants, the way the workers used to operate the machinery and the conditions in which the working people were living in these plants.

During the second period of his stay in Manchester, despite his work at the mill, Engels found time to write his famous work on Luther, the Reformation and the revolutionary war of the peasants in 1525 (*The Peasant War in Germany*).

Engels followed developments in science very closely. He planned a major work setting out his approach to science, its history, place in society and the philosophical arguments surrounding it – but never completed it. Notes survive – some complete chapters, others in very rough form – which have been collected together and published as *The Dialectics of Nature*. Engels never managed to fully develop his ideas. He was forced to break off work on *The Dialectics of Nature* to deal with arguments inside the then growing socialist movement. In Germany a now long forgotten professor, Dühring, had become fashionable among sections of the German workers' movement. Engels was urged by Marx, to write a polemic against Eugene Dühring. Engels intended to resume work on *The Dialectics of Nature*, but was prevented from doing so by Marx's death.

This Symposium will develop along two axes: In the first axis we will analyze the actuality of Engels work, his influence on debates in the history and philosophy of science and technology throughout the 20th century and discuss its critics highlighting that Engels developed methods which are essential today for any further advance in the understanding of science and its utilisation for human welfare.

In the second axis we will explore in detail Engel's work, especially *The Dialectics of Nature*, which has attracted a large body of criticism. Emphasis will be given in Hegel's ambivalent influence on the work of Engels and also in Engels contribution in the unveiling of the historical dimension of the physical world.

S031-A. The actuality of Engels' work

Wed 24 July, 09:00–10:30 ▪ Uni Place 4.213

Chair: Robert HALLEUX | University of Liège, Belgium

Polina CHRYSOCHOU | Anglia Ruskin University, United Kingdom

Engels and the debate on women's oppression

Engels developed a theory of women's oppression in the publication of "The Origin of the Family, Private Property and the State" (1884) based upon the pioneering research work of Lewis Henry Morgan "Ancient Society" (1877). His work was the first materialist attempt to understand the evolution of human social organization.

Engels developed a theory of how the rise of class society led to both the rise of the state and the rise of the family, as the means by which the first ruling classes possessed and passed on private property thus locating historically the source of women's oppression. Engels' work has defined the terms of the debate around the origin of women's oppression since the appearance of the feminist movement. Most writers on the subject of women's oppression have set out either to support or reject Marxist theory based on a critique of Engels pioneering work. In this paper, I present the essence of his theory and discuss the points of controversy.

Dominique MEEÛS | Institut d'études marxistes, Belgium

Friedrich Engels and the unveiling of the historical dimension of the physical world

Marx and Engels showed that the history of the human world is not static, nor even cyclic, but is a forward movement, that can be explained and, to a certain extent, predicted (Communist Manifesto). This history cannot be understood without considering the necessity for the human animal to provide the means of existence for itself by work (production) in certain social relations. Marx untangled an unsolved problem of classical political economy, the origin of wealth under capitalism, by making the difference (surplus value) between the work done by a worker and the work necessary to provide his or her means of existence. Engels may be associated with this breakthrough. For the physical world, Newtonian mechanics proved extremely fruitful but its very success could induce a mechanistic, static view of the world. Engels is remarkable for having seen in some of the advances of science in his time the sign that the physical world too has a history. Already in the Newtonian heritage, there were hints in that direction, like the origin of celestial bodies or the slowing down of the Earth by the tides (Laplace, Kant...) Engels felt the importance of conservation and transformation of energy, of biological evolution (geology, Lamarck, Darwin...), of the unity of the biological world based on the cell. Observing the advances of organic chemistry he stressed the unity of the whole, together with its evolutionary character, from inanimate matter to life, to mind and to society.

Robert HALLEUX | University of Liège, Belgium

Friedrich Engels and the steam-engine

In his ground-breaking work, "The Condition of the Working Class in England", Engels argued that the history of the proletariat was bound up with the invention of the steam-engine and "machinery for working cotton" in the second half of the 17th century. These instruments gave rise to the industrial revolution which produced new instruments of labor, new industries, a new social structure, and new living and working conditions. Engels says that in his age that the greatest advance in human control of nature, and thus in freedom, was the invention of the STEAM ENGINE and the modern world that it has made possible. Engels thought that the steam engine had so increased the productive forces of humankind that we could, in the age of steam, solve social inequalities. For the development of the productive forces "make possible a state of society in which there are no longer class distinctions" in which there be will enough socially created product for all and "for the first time there can be talk of real human freedom"-- that is, "of an existence in harmony with the laws of nature that have become known."

S031-B. Analyzing Engels' work

Wed 24 July, 11:00–12:30 ▪ Uni Place 4.213

Chair: Kostas SKORDOULIS | National and Kapodistrian University of Athens, Greece

Kostas SKORDOULIS | National and Kapodistrian University of Athens, Greece

The environmental thought of Friedrich Engels

This paper argues that the environmental concerns of Engels were central in the development of his notion of materialism and that his materialist critique of industrial capitalism can be considered as the birth point of the environmental movement. Engels' environmental masterpiece, "The Condition of the Working Class in England (1844)", contains an early critique of Malthus as well as the development of the notion of the reserve army of the unemployed. Engels' work is also a striking portrait of the conditions of the working class in the industrial towns of England. Engels provided a walking tour of the environmental conditions in the manufacturing establishments and slums of the factory towns of England, addressed conditions of widespread pollution focusing especially on environmental toxins and public health conditions, and the impact that these had on workers — including air pollution, lead poisoning, skeletal deformities resulting from malnutrition, and diseases spread by unsanitary water. For Engels, "The Condition of the Working Class in England" was to be the first of a series of connected analyses of ecology that stretched through more than half a century and included his seminal and much disputed work "The Dialectics of Nature". Here, he argues for the necessity of a materialist conception of nature, insisting on a dialectical approach to materialism, as opposed to mechanical (or mechanistic) materialism. These works make him one of the most important but underappreciated contributors to the development of environmental thought.

MAZURKIEWICZ Stany | University of Liège, Belgium

Hegel's influence on the Dialectics of Nature of Engels

In my paper I would like to show that Hegel had a real influence on Friedrich Engels' way of thinking in his "Dialectics of Nature". Indeed, Engels had a huge knowledge of his time sciences and techniques but also a theoretical frame in which he thought it: Hegel own dialectic of nature. Engels is constantly taking position in relationship to Hegel (for or against) and want in the end to rewrite a new dialectic of nature (he didn't completed), what we can follow according to his letters. We can also learn that history of science is the real dynamic why Engels refuse or accept theories in Hegel (the most important difference is of course Darwinism; for Hegel, he is clear about it, nature has no history). Seeing the origins of Engels' thought can help to understand and put it into perspective for the one who would like to thing today's sciences.

Discussion

General discussion, including commentary from the symposium organisers

S033. Paris: capital of hygiene?

Tue 23 July, 09:10–12:40 ▪ Uni Place 4.212

Symposium organisers:

Fabienne CHEVALLIER | Musée d'Orsay, France

Peter SOPPELSA | University of Oklahoma, United States

Symposium abstract

Our symposium answers the ICHSTM call for studies of "knowledge at work" by examining hygiene's essentially applied-and urban-character. The modern city was both the social context that spawned the science and its main object of study and field of application. At the intersection of urban studies and histories of science and medicine, a significant body of research now examines the reciprocal impact of science and urban environments (see esp. *Science in the City*, Osiris vol. 18 [2003], focused largely on Paris). We trace hygiene's concrete application in nineteenth- and twentieth-century Paris, asking how Paris's local history of hygienic intervention into the built environment and daily practices supports or contradicts its oft-noted urban identity as a global "crucible" and "capital of reference" for hygienic science (Chevallier 2010). Treating topics from physical fitness and food to death, medicine, noise pollution, and international expositions, our six papers track hygiene through studies of architecture and urban planning, urban ecology, medicine, the body and its senses, and transnational urban networks. Only this interdisciplinary approach can capture the manifold character of urban hygiene, which itself was a sprawling, interdisciplinary field that ranged far beyond medicine and public health. Finally, we aim to continue bilingual dialog among scholars of France in Europe and North America.

S033-A. Food, fitness, and fatality: hygiene and bodies

Tue 23 July, 09:10–10:40 ▪ Uni Place 4.212

Chair: Peter SOPPELSA | University of Oklahoma, United States

Sun-Young PARK | Harvard University, United States

Building Bodies: swimming schools, fitness, and hygiene in early nineteenth-century Paris

This paper will examine how a political need to re-stabilize the nation's physical and moral health gave rise to new practices and spaces of hygiene in early 19th century Paris. In the era following a series of military defeats that culminated in Napoleon's fall at Waterloo, concerns over racial degeneration prompted new medical thought on the body. As argued by hygienists and scientists of the period, doctors had failed to consider that human beings, like animals, could be bred to modify and refine their physical condition. The study of hygiene should thus extend beyond the preservation of health and prevention of illness to concern itself with the improvement and perfection of the human body.

These developments in medical thought came to have a significant impact on the Parisian built environment. In promoting exercise and fitness, these ideas on *l'hygiène physique* called for the creation of new kinds of spaces devoted to the body. The early 19th century swimming school was one of the sites where this emerging medical knowledge was put into practice. During the first decades of the 19th century, the number of these floating swimming pool barges along the Seine more than doubled, as the healthful benefits of physical activity were

expounded upon. As spaces dedicated to exercise, bathing, and recreation, these venues allowed ideas of fitness, cleanliness, and pleasure to conflate. In this paper, I will explore how institutions such as the Ecole Deligny on the Quai d'Orsay and the Ecole de Henri IV on the Pont Neuf gave form to medical theories, transforming both the Parisian urban landscape and 19th century physical culture.

This paper thus situates the prescriptions that were put in place to reform the physical body in the early 19th century at the epistemological juncture of science, politics, and space. By examining the hygienic theories informing the creation, use, and growing popularity of early 19th century swimming institutions, I will demonstrate the ways in which medical knowledge at work could impact not only practices and ideas, but material environments as well.

Sabine BARLES | Université Paris 1 Panthéon-Sorbonne, France

Assainir et nourrir, des enjeux urbains convergents, France, XIXe siècle

L'historiographie a longuement observé les transformations urbaines du XIXe siècle à l'aune de l'hygiénisme et de la réticulation. Le méphitisme des villes françaises (et européennes) est en effet dénoncé par le corps médical de façon insistante depuis le XVIIIe siècle, selon une analyse néo-hippocratique qui attribue au milieu les causes premières de la maladie et de la mort. L'hygiénisme, d'abord avatar du néo-hippocratisme, reprend cette analyse à son compte au siècle suivant, et explique, en association avec le rôle croissant des ingénieurs, la rectification entreprise dans nombre de villes. L'évacuation des excréta urbains fait partie de ce projet. Les transformations opérées dans les villes non seulement en termes infrastructurels mais aussi en matière de gestion de l'environnement urbain ne peuvent néanmoins être appréhendées selon ce seul prisme, qui est pourtant privilégié dans la littérature. L'amélioration des conditions de salubrité est en effet associée à une autre préoccupation, celle de l'alimentation. On craint alors l'émergence d'une crise alimentaire ; les chimistes et les médecins se préoccupent de nutrition. Contre « La faim sortant du sillon et la maladie sortant du fleuve » (V. Hugo), ils mettent non seulement en place un cadre d'analyse commun des excréta et des aliments, principalement fondé sur leur teneur en azote, mais aussi ils font de la gestion des excréta un enjeu alimentaire : assainir c'est aussi nourrir. La plupart des techniques qui seront mises en œuvre dans les villes reposent sur ce principe. La communication, basée sur la littérature technique et scientifique du XIXe siècle et sur des recherches en archives, explorera, dans le cas français, cette complémentarité entre assainissement et alimentation, et ses conséquences urbaines.

Jonathan STRAUSS | Miami University, United States

Miasma theory in nineteenth-century Paris, or, the animate death of dead life

This paper focuses on a particularly important aspect of hygiene in nineteenth-century Paris: miasmas, especially as they involved the relations between life and death. While scholars such as Alain Corbin have devoted significant attention to the theorization of miasmas in eighteenth- and nineteenth-century France, the effects of that theorization on contemporary concepts of death, especially in urban space, have passed unnoticed.

The earliest—and in some ways most important—clinical studies on the relations between life and death emerged in the work of pathologist Bichat and his followers Broussais, Buisson, and Legallois. In defining the limit between life and death, this group concentrated on the relations between different organs and the properties of animal tissues, notably “irritability.” Life, for these clinicians, was defined as “the group of forces that resist death,” but the actual nature of death remained unclear.

As the influence of the pathologists faded later in the century, it yielded to miasma theory, which had been growing in importance and sophistication since the mid-eighteenth century. Although miasma theory

would give way, in turn, to Pasteur's concept of microbes, the paradigm shift was less abrupt than is often believed. In the 1860's and '70's, medical and hygienic theory hesitated between the two approaches, with miasma theoreticians inflecting the reception and understanding of microbes.

This paper demonstrates how miasmas were related to putrefaction and fermentation, arguing that the latter, in particular, enjoyed an ambiguous ontological status as a fundamental process of either life or death. In one of his final lectures (1876), Bernard could declare that “life is nothing but rotting.” The next year, however, Cadet referred to the “germs of death” released by miasmas.

As this paper shows, the controversies around miasma theory put a profound uncertainty at the heart of nineteenth-century French hygiene: were putrefaction and resulting miasmas manifestations of life or of death? For the numerous influential proponents of the latter view, death was a positive and physical presence, which was especially dense in the urban environment. Thus, in 1868, de Werchin described “the animate death of dead life (fermentation),” spreading from human cadavers and propagating cholera throughout entire populations. The city, from this important if long forgotten hygienic perspective, was a concentration of objective and physically present death.

Commentary: Andrew AISENBERG | Scripps College, United States

S033-B. Administering the hygienic city: regulation and reform

Tue 23 July, 11:10–12:40 • Uni Place 4.212

Chair: Sabine BARLES | Université Paris 1 Panthéon-Sorbonne, France

Fabienne CHEVALLIER | Musée d'Orsay, France

The rise of hygienic icons in Parisian urban architecture

In 1882, the Société de Médecine Publique et d'Hygiène Professionnelle publishes *L'Etude et les Progrès de l'Hygiène en France de 1878 à 1882*, an official assessment of the results of the policies of the Third Republic in the field of Hygiene. The foreword is signed by Professor Paul Brouardel (1837-1906), chairman of the Société, member of the Comité consultatif d'hygiène de France, and a leading figure of the Faculty of Medicine. Brouardel was a specialist of legal medicine. When the modern Morgue of Paris was built on the Ile de la Cité (architect Jacques-Emile Gilbert, 1861-1864) during the Second Empire, Brouardel created a class in this new building, where he could show his students how to practice autopsies.

An important part of *L'Etude et les Progrès de l'Hygiène en France de 1878 à 1882* deals with the quality of architectural constructions. It includes descriptions of certain buildings that are classified according to the architectural programs they belong to, with a wide range of schools and hospitals. Credit is given to the most remarkable buildings for their sanitary and scientific qualities. At that period of the Third Republic, Professors of Medicine had acquired a long-lasting experience in the field of public architecture through their growing involvement in the comité d'hygiène et de salubrité du département de la Seine, created in 1802 by the Préfet de police. With *L'Etude et les Progrès de l'Hygiène en France de 1878 à 1882*, the medical profession assesses its point of view on Modern architecture and its icons, with a special focus on Paris.

In this paper I shall show that the relation between Medicine and Architecture, in the sense that progress made in Medicine gives an impetus to Modern Architecture, traces its origins during the Eighteenth Century. I shall comment on five major moments of this emulating relation through selected examples, including the climax of 1882. The year 1769 provides the first moment. On that year, architect Jacques Gondouin receives the commission of the new Ecole de Chirurgie (now

Faculty of Medicine), where he uses the neo-classical language for the building and for the amphitheater of anatomy, which becomes a model. After a discussion on the role of Germain Boffrand as a forerunner of « Urban Hygiene », the following examples belong to the nineteenth century. They explore the impetus given by Hygiene to modern architectural typologies in the field of markets, hospitals and schools. The year 1882 is a climax because the Société de Médecine Publique acts as an Academy of Modern Architecture, in order to promote actively a new architecture that meets the needs of citizens. In a brief conclusion, I shall bring new perspectives on the role of Hygiene for the rise of Modern Architecture.

Peter SOPPELSA | University of Oklahoma, United States

Making a global network hub: Paris as hygienic host city, 1851-1938

Following our symposium's urban history orientation, this paper examines the Third Republic's attempt to make Paris a world capital of hygienic theory and practice, a leader in hygienic science, reform, and design. Recent research in urban exposition studies (Miriam Levin, Julie Brown, and Alexander Geppert) has theorized the reciprocal influence of international events like world's fairs and the urban cultures and urban planning of the cities that host them. This paper continues this discussion by investigating how Paris was groomed as the leading host-city for international hygienic events. It posits three principal strategies for "grooming" the city: first, capitalizing on Paris's existing cultural capital; second, taking on and sharing international responsibility for hygienic science and policy; and finally, competing in tropical/imperial medicine and the global "chasse aux microbes". It examines more than fifteen hygiene-related international events hosted by Paris between 1851 and 1938, including: seven International Sanitary Conferences (1851, 1859, 1894, 1903, 1911–1912, 1926, and 1938); five congresses held during Universal Expositions—three International Congresses of Hygiene and Demography (1878, 1889, 1900), and two International Medical Congresses (1867, 1900); and finally, smaller, specialized events like the International Congresses on Tuberculosis (1893, 1905), and the International Congress of Sanitation and Housing Health (1904).

According to the Third Republic's "civilizing mission," hygiene was a cornerstone of civilization both in France and in the colonies. Thus, while Paris hosted these events, France was casting a global net of hygienic influence through branches of the *Pasteur Institute* established in foreign countries in conjunction with the *Corps de Santé des Colonies* and the so-called "Pastorian missions." French labs opened around the world, from Saigon (1891) to São Paulo (1903) and Saint Petersburg (1923). Thus, by both centralizing hygienic activity in Paris and globally distributing expertise, the Third Republic tried to position Paris as the hub of a global network. Finally, by examining international sources as well as French sources, this paper will analyze reactions to Paris as a host city. How did foreigners visiting Paris regard it as a host city? To what extent did Paris succeed in becoming a capital of hygiene? How did this impact the city's broader reputation as "capital of the nineteenth century," "capital of modernity," or "Queen City of expositions"?

Rebecca SCALES | Rochester Institute of Technology, United States

'We are living in the century of noise': urban hygiene and noise abatement campaigns in Paris, 1919-1939

"Noise is the most distinctive characteristic of our modern world," the popular French health magazine *Guérir* cautioned its readers in 1933, and the very sounds that defined interwar urban life—honking automobile horns, the strident squeals of loudspeakers and public address systems, the echoes of radios and phonographs, and the hums of factory and office machines—constituted far more than a nuisance to city residents. To many contemporaries, noise appeared to threaten the mental stability, physical health, and vitality of the French nation at a moment

when legislators and physicians alike worried about the rise of a vigorous and health-obsessed German population across the Rhine.

This paper will examine Paris as the birthplace of France's first national noise abatement campaigns: the Touring Club de France's *La lutte contre le bruit* and the *Ligue de légitime défense contre le bruit*. In rallying a Parisian bourgeoisie discomfited by a cacophonous capital to demand noise regulations, both organizations relied heavily on the arguments of physicians and urban hygienists. René Martial, the Municipal Director of Hygiene, and Edouard Toulouse, the celebrity alienist, both argued that noise could turn city dwellers into *déséquilibrés* resembling shell-shocked veterans of World War One. Since Parisian urban hygienists had long focused on water supply, sewer construction, and trash removal as the keys to creating a healthy and disease-free city, the interwar noise abatement societies sought to quantify urban noise as a legitimate health concern by drawing on recent scientific and technological innovations in audiometry and architectural acoustics by hiring engineers to measure street noise and test sound-absorbent construction materials.

Yet regulating the soundscape of Paris quickly proved to be a challenging task, pitting individual radio owners, businessmen, and vehicle owners against neighborhood policemen, concerned citizens, and municipal authorities. However, by the 1940s the French state and Parisian politicians acknowledged noise as a genuine health concern that demanded regulation at the municipal, regional, and national level. Medical considerations of noise as a hygienic concern during the interwar decades consequently shaped urban development into the late twentieth century.

Commentary: Andrew AISENBERG | Scripps College, United States

S034. From patronage to biotech: new perspectives on medicine and commerce

Thu 25 July, 09:00–12:30 • Uni Place 4.206

Symposium organisers:

Stine Slot GRUMSEN | Aarhus University, Denmark

James STARK | University of Leeds, United Kingdom

Symposium abstract

This symposium aims to shed new light on the shifting relationships between medicine, medical practice and commerce in the modern period. Following Roy Porter, historical narratives of the medical marketplace have largely concentrated on the emergence of the medical trade in the early modern period. Yet, commercial activity centred on medicine increased dramatically during the nineteenth and twentieth centuries, and set a precedent for the current climate. Worldwide markets for medical products and doctors' services continue to expand as a result of such developments, controversially in some cases. We therefore seek to redress this imbalance in the historical literature by exploring three broad themes from the seventeenth to the late-twentieth century:

The importance of loci or spaces of conjunction between medicine and commerce, from the Medici Court to dental journals, from newspapers to biotech laboratories;

The impact of the relationship between medicine and commerce on the work of historical actors, considering intermediaries such as manufacturers, retailers and advertisers in addition to doctors and patients;

The exchange and transformation of knowledge, materials and practices between those connected with the healthcare industry broadly construed.

Across all papers, the deployment of knowledge, skills and practices is central. Medical and technical knowledge was put to work designing and making new products, and practitioners who became involved in such activities saw the lines of their own work become blurred; their interests became divided between professional and business domains. Knowledge acted in a transformative way, and was itself transformed; theoretical innovations in medicine impacted on the tools, techniques and therapies associated with healthcare and medical treatments, and vice versa. Further, medical knowledge was used in new and surprising ways to sell products to a broad range of consumers. This symposium offers an opportunity for historians to reflect on the medicine-commerce nexus, and to initiate new lines of enquiry into this important emerging area of scholarship.

S034-A

Thu 25 July, 09:00–10:30 ▪ Uni Place 4.206

Chair: Stine Slot GRUMSEN | Aarhus University, Denmark

Claire L JONES | University of Leeds, United Kingdom

Under the covers? The supply and marketing of contraceptives to British householders, 1860-1960

By the 1960s, Britain was home to a booming trade in mechanical contraceptives, a trade which would have been unrecognizable one hundred years earlier. What had been a small underground network of individual sellers of 'French Letters' during the early half of the nineteenth century became a profitable industry, which offered consumers a range of contraceptives from chemists' shops, vending machines, birth control clinics, and via mail order. Yet, while there has been much debate about the role of contraceptives in demographic transitions and changes in sexual and familial relationships, the significance of industry during this period in attempting to appeal to householders has been largely tangential to discussions; historians are yet to assess in any detail how the British contraceptive industry developed prior to the introduction of the pill. This paper sketches an outline of the changing ways in which companies, vendors and distributors attempted to appeal to British householders with contraceptives of increasingly variety between 1860 and 1960. Acknowledging the significance of both supply and demand, it provides a broad survey of some of the hitherto unexplored but prolific British producers, distributors, and advertisers of contraceptives in this period, but also highlights what their strategies might reveal about consumer responses. Limited evidence has long prevented historians from accurately tracing trends in contraceptive consumption and from identifying consumers. Yet, this paper argues that uncovering transformations in contraceptive supply and distribution can be an important first step in indicating sites of consumption and in demonstrating increasing acceptance of contraceptives as products among British householders.

James STARK | University of Leeds, United Kingdom

Patents, testimonials and appeals to authority: the marketing of Overbeck's 'Rejuvenator' around 1924-1937

Electrotherapy is an approach to treatment which still has a place in medical practice. Techniques such as deep brain stimulation and electro-convulsive therapy are two of the most highly medicalised applications of electrotherapy. Yet, as this paper argues, in the early twentieth century devices were marketed by companies to the general public, bypassing the medical profession. One such electrotherapy device was the "Rejuvenator". This was developed by Otto Overbeck, a

British chemist who made his name as Scientific Director of a brewing firm in Grimsby, a provincial fishing town. Overbeck patented a number of modifications to brewing technologies during the first decade of the twentieth century, and later turned his attention to electrotherapy. He patented his Rejuvenator, which he claimed could be used to treat a vast variety of conditions, very widely from the 1920s onwards. The patents themselves were part of a broader marketing strategy, which included testimonials from practitioners and users, appeals to Overbeck's scientific credentials, and claims of manufacturing integrity. Overbeck was able to pursue such strategies precisely because he was a chemist rather than a clinician, and therefore did not have to abide by professional codes of conduct which applied to other medical innovators. This paper argues that patents gave credibility to the Rejuvenator, and convinced potential purchasers that the device would work to treat a vast array of different illnesses and ailments. Overbeck's goal was to legitimise his device, and to persuade potential consumers that it was a viable alternative to professional medical advice. In doing so, Overbeck incurred the wrath of both the British Medical Association and the Australian government when advertising and selling his device on a global scale. Using the Rejuvenator as a case study, this paper shows that there was a complex relationship between the marketing of medical devices, patents and electrotherapy in the early twentieth century.

Lori LOEB | University of Toronto, Canada

Desperate housewives: consumers of medicated wines and their protectors in early twentieth-century Britain

In early twentieth-century Britain temperance reformers argued that unsuspecting women were being led down a slippery slope to alcoholism by medicated wines. Medicated wines were a form of patent medicine taken daily by some women as an apparently harmless pick-me-up. Most of them contained large quantities of alcohol. But three factors might encourage consumers to think otherwise. Makers did not declare the alcoholic content of medicated wines on product labels. Second, advertisements for medicated wines, which were among the most florid in the business, portrayed them as innocuous and emphasised that doctors recommended them broadly for general convalescence, fatigue and ailments associated with maternity. Third, the point of sale did not suggest alcoholic content because most medicated wine was sold in unlicensed department and grocery stores. To members of the UK Alliance, a leading temperance organisation, these three factors constituted a misrepresentation of the product which was luring innocent women to inebriety and destroying their lives. They launched a campaign to restrict the sale of medicated wine. This paper argues that it failed because temperance reformers argued that doctors agreed with them that medicated wines were dangerous. Evidence from the Alliance News, the official magazine of the United Kingdom Alliance, testimony before the Select Committee on Patent Medicines in 1911 and a highly publicised court case, *Bendle v. the Alliance News* in 1913, reveal that doctors, in fact, recommended medicated wines to their patients in droves. Certainly, the temperance lobby was correct that many of the popular brands contained at least fifteen per cent alcohol. Others contained small amounts of cocaine. It is true that neither ingredient was disclosed on product labels. On this basis, representatives of the UK Alliance contended not only that the substances were addictive and misrepresented, but also that the testimonials from doctors, which were central to the advertisements of all medicated wines, were invented and fraudulent. Unfortunately, investigation proved otherwise. Not only did doctors recommend medicated wines in defiance of professional ethics, some doctors held positions on the board of directors of medicated wine companies. Even the claim that medicated wines were nutritious wound up having medical supporters on both sides. In the end, by trying to damage the medicated wine business, temperance reformers exposed the weaknesses of their own arguments and unwittingly helped the tonics to thrive through the inter-war period and beyond.

S034-B

Thu 25 July, 11:00–12:30 ▪ Uni Place 4.206

Chair: James STARK | University of Leeds, United Kingdom

Stine Slot GRUMSEN | Aarhus University, Denmark

Zeal of acceptance: balancing professional ideals and the financial situation of the Journal of the American Dental Association 1930-1931

In April 1931, the American Dental Association's Seal of Acceptance was introduced. It has been – and still is – widely praised as a symbol of safety, efficacy and credibility within dental therapeutics and an icon of professionalism for the American Dental Association. This paper traces the complex history of the introduction of the Seal of Acceptance and argues that the introduction revolved around personal zeal and struggles for the authority associated with the acceptance programme that had been launched in 1930 and was administered by the Council on Dental Therapeutics of the American Dental Association. The acceptance programme became a financial thorn in the side of the Board of Trustees of the American Dental Association and the editor of the Journal of the American Dental Association, as it reduced the revenue of the advertising section of the journal significantly. However, other parties in the conflict, including several members of the Council on Dental Therapeutics, interpreted the dwindling support from the Board of Trustees as undermining the professional ideals of the American Dental Association. The struggles to balance professionalism and finances came to open conflict in the journal as well as at a general meeting of the Chicago Dental Society's Midwinter Clinic in 1931. Recently distributed power was withdrawn from the Council on Dental Therapeutics as the Board of Trustees sought to consolidate the journal's financial situation. The American Dental Association's Seal of Acceptance served as a tool in the redistribution of authority in this intra-professional conflict.

Graeme GOODAY | University of Leeds, United Kingdom

Hearing assistive technologies at the complex interface of medicine and commerce

Since the early nineteenth century, companies manufactured devices specially designed to assist the hard of hearing in conversation. In Britain these were available commercially from high street vendors of prosthetics, or for purchase by mail order; in neither context were they primarily marketed or purchased as medical products. Many such mass manufactured devices were patented to secure protection against plagiarists in this lucrative market, or to signal their presumptive efficacy. By contrast, clinical interventions rarely provided therapeutic relief, sometimes even exacerbated hearing loss. So up to the early twentieth century, medical involvement was customarily limited to advice on reputable high street vendors of hearing aids. In treating victims of brutal combat conditions in Europe's Great War, however, it became clear that hearing loss could be both a physiological and psychological phenomenon. Certain kinds of disability assistance were recognized by governments as appropriate to hearing loss newly valorised as a war injury deserving compensation. Thus in the interwar period, the medical profession took a greater interest, staking a claim in this territory. Some manufacturers took advantage of this and solicited medical inspection and approval of their products to differentiate themselves from downmarket opportunistic mail order products. This was especially important for assuring the safety and efficacy of new kinds of electronic amplification derived from telephony and radio. Such devices proved to be especially important supporting the many victims of hearing loss created in Second World War combat conditions. Indeed the sheer scale of those conditions precipitated the rise of the new medical profession of audiology whose specialist prerogative it was to diagnose the particularities of each human subject's condition and to prescribe a tailored technological solution. This harmonious symbiosis of technical expertise and medical authority in handling hearing loss began to break down with the arrival of the National Health Service in 1948. In that year, free hearing aids became standardly available for a large low-income

constituency of the population. These "Medresco" models were produced by the Post Office telecommunications section in collaboration with the Medical Research Council: this appalled and alienated the well-established community of private commerce which was thereby completely excluded from state hearing aid provision. The uncomfortable rift took a rather different form in the USA. There hearing aid manufacturers kept much stronger control over access to hearing aids within private healthcare provision. Indeed it was not until the 1970s that US audiologists were permitted to prescribe hearing aids at all. Overall then we see that the story of hearing aids sheds light on the complex contingencies through which the medical professions and commercial industry delineated boundaries for their prerogatives in healthcare.

Agata IGNACIUK | University of Granada, Spain

The introduction of oral contraceptives into non-democratic regimes: the cases of Poland and Spain, 1960s-1970s

The pill, often called one of the first lifestyle drugs, was designed to be consumed not by sick patients to treat an illness, but by healthy women to prevent pregnancies. Moreover, it has influenced patient-doctor relationships, as women started to openly request this prescription drug. Furthermore, the debates about side effects of the pill were crucial in setting contemporary standards for testing and legal regulation of drugs. While the introduction of oral contraceptives onto international drug markets has been extensively studied, less attention has been paid to how these drugs were introduced and circulated in countries with non-democratic regimes, with their specific market regulations and drug policies. In this paper, I demonstrate how pharmaceutical companies' possibilities of introducing their products to the Polish and Spanish markets were delineated by political and economical concerns that also affected the doctors' interest in these drugs and women's access to them. In Spain, the circulation of the pill grew from 1964 onwards. However, it was not marketed there as a contraceptive until the late 1970s, because the right-wing, conservative, Catholic regime of General Franco established laws which prohibited sale and advertising of contraception. Instead, pharmaceutical companies introduced their products as therapeutic drugs for menstrual disorders. The Spanish medical press of the 1960s commented that gynaecologists expressed scientific interest in these new drugs but in many cases rejected them on the grounds of religious beliefs. During the 1970s, however, some more liberal doctors advocated women's access to birth control. The importance of Catholicism in the public sphere and medical profession during the Francoist regime did not completely prevent women, especially those from middle and upper classes, from accessing the pill, and its sales rose steadily along the 1970s, but the pill did not and has not become first-choice contraceptive method in Spain. In socialist Poland, where there were no legal limitations to contraception, and abortion had been widely practised since its legalisation in 1956, gynaecologists, as their Spanish counterparts, started to work with different brands of Western contraceptive pills in the early 1960s. In 1969, the first commercial Polish pill, "Fernigen", was produced. During the 1970s, pharmaceutical companies outside the Eastern bloc could not access these markets, hence only few brands of oral contraceptives were available in Poland, most of which were manufactured by the national pharmaceutical industry. The circulation of the pill was limited, and despite the declared favourable attitude of the state socialist regime towards birth control, the pill had not become a method of choice among Polish women.

Takahiro UEYAMA | Keio University, Japan

Crossing the boundary between public and private science: patents, finance, and start-ups in the 1970s and 80s in the US

On December 10, 1980, the Times published an article entitled "Harvard University, Inc.?" It reported that Harvard was in the midst of a serious controversy among its leading faculty members regarding the

university's equity-partnership with a private company. Shortly before this exposé, Derek Bok, the president of the university at that time, announced a plan to invest part of its endowment in a newly launched bio-tech company. The Times was alarmed that this prestigious edifice of academia, which had received millions of dollars in public funds from the government, was turning its research results into a monetary engagement. Seeing this as a symbolic revelation, the House of Representatives organised a subcommittee in 1981 to investigate the ethical and institutional impacts of commercialising university biomedical research. Harvard was not unique in its actions. From the late 1970s, particularly in the life sciences, researchers had become more and more interested in filing patents for their discoveries and even went so far as to establish their own startups. What triggered this change were fundamental discoveries and innovations in biotechnology that followed in succession. Further, the Bayh-Dole Act of 1980 officially allowed universities to retain title to intellectual property resulting from federally funded research performed in their laboratories. This law not only enabled universities to secure promising royalty agreements but also strongly encouraged them to license their patents to small business enterprises. It aimed to foster startup endeavours through the transfer of innovation seeds planted in universities to the private sector. A remarkable example was Genentech, which was established in 1976 as a partnership between Herbert Boyer and Robert Swanson, a famous venture capitalist. What we see here is the traditional demarcation between "public" and "private" science jeopardised by double meanings. On the one hand, by directly encountering market activity, academic pursuits as a public good was trapped by the hope of private gain through commercial sponsorship. But on the other hand, granting private intellectual property status to living organisms or DNA sequences became a 20th Century "enclosure" of natural resources, which should be freely available in the public domain. Given these contradictions, in this paper I would like to explore several topics, including the discussions that the presidents and research directors of elite universities revealed in the House of Representatives, the Recombinant DNA controversy at the Asilomar Conference, the molecular biologists' entrepreneurial commitments to private companies, and a comparison of patent policies between Stanford and UC Berkeley. In so doing I will examine the complexities and ambiguities that US academia had to confront in the 70s and 80s.

S035. Image and context: visual representations and the boundaries of scientific practice

Wed 24 July, 09:10–10:40 • Roscoe 1.008

Symposium organisers:

Ari GROSS | University of Toronto, Canada

Amir TEICHER | Tel Aviv University, Israel

Symposium abstract

What functions do visual representations play at the intersection of scientific practice and broader society? Historians and philosophers of science are now adept at noting the critical importance of visual practices to certain aspects of scientific thought. It has been well established that epistemically-significant images are never "mere" representations of the world. Images are well known to have the capacity to embody theoretical assumptions, to turn information into arguments, and to permit or deny certain forms of reasoning. In addition, visual representations are often employed in variety of contexts that transcend their initial origins.

In the symposium we will explore the various roles that images play as they straddle the boundaries between the professionalized realm of

practicing scientists and the broader public. How do practical visual technologies become transformed in both content and context as they move from being tools of knowledge generation and transmission to objects of wonder, epistemic authority, and consumption? How do technical visual conventions function as tools of communication, reasoning, and education in the broader contexts of artistic conventions, cultural standards, and moral and political values? How might the functions of single image change as it moves through different audiences and contexts? And finally, how do extra-scientific images and models come to shape the imaging and modeling practices of scientists? By asking these questions we wish to gain insight into the complex relationships between images, their creators, and their consumers, as well as into the ill-defined boundaries of the sciences and their publics.

The panel includes four presentations, gradually moving from the scientific to the popular sphere. Arik Hinkis (Tel-Aviv University) will look into the role of visual imagery in reaching and substantiating mathematical proofs, offering an insight into the use of graphs in scientific thinking and in the communication of mathematical theorems. Amir Teicher (Tel-Aviv University) will survey the changing roles of pedigree charts and their academic and propagandistic usage in early 20th century German psychiatry. Ari Gross (University of Toronto) will discuss the complex and multi-faceted contexts of anatomical representations, including flap-book anatomical mannequins and the plastinations used in the (still running) Body Worlds exhibits. Finally, Eleanor Louson (York University) will describe the representation of animal behaviour in wildlife films, and how this narrated portrayal of wildlife, combining entertainment and education, feeds back on our conceptions of both nature and human family values. Altogether, we wish to highlight both the constant and the changing features of the visual domain and its functions in the creation, communication and consolidation of scientific knowledge.

Chair: Amir TEICHER | Tel Aviv University, Israel

Arie HINKIS | Tel Aviv University, Israel

The imagery of gestalt and metaphor in mathematical proofs and its relevance to proof comparison

Many mathematical theorems have a number of proofs. Can the different proofs be methodically compared? We suggest that mathematical proofs can be described by a series of gestalts, with metaphors attached to each gestalt switch. The comparison of proofs can then be affected by comparing the proofs through their gestalt and metaphoric descriptors. To establish proof descriptors linguistic imagery, graphics and associations into art and poetry are applied. We will exemplify the suggested method for the case of the Cantor-Bernstein Theorem, an elementary but not trivial theorem of set theory. We will look at about half a dozen proofs of the theorem and compare them through their gestalt and metaphoric dimensions. The processing of proofs for their imagery descriptors may unravel internal links between proofs of different theorems, stemming seemingly from different contexts. We will exemplify this observation by relating Bernstein's proof of his division theorem, to one of the proofs of the Cantor-Bernstein Theorem. We will briefly further note how the imagery derived from another proof of the Cantor-Bernstein Theorem affected a research project which led from Bernstein's Division Theorem to important results in graph theory and topology. We will conclude with remarks on the possibility that the imagery of proof descriptors forms the arsenal of a mathematician, and is the touchstone for the semiformal discourse among peers. We will point out that to further our knowledge on these subjects more study is required in the internal history of mathematics and the anthropology of the mathematicians' community.

Amir TEICHER | Tel Aviv University, Israel

Drawing the lines: the disturbed nature of psychiatric pedigrees

In the beginning of the 20th century, German psychiatrists used pedigrees to disentangle the mechanisms underlying hereditary processes. Visualizing genealogical relations in a pedigree form served at least three ontologically distinct purposes. First, pedigrees were analytical devices which were supposed to bring to the fore certain regularities and thus facilitate the researcher's ability to identify biological laws pertaining to the hereditary nature of mental illnesses. Second, pedigrees were used to document and communicate research results to peers in the scientific community. Finally, pedigrees were frequently reproduced and presented as part of an effort to propagate eugenic agendas to the German public. Using the same visual tool for different, not necessarily overlapping goals raises certain methodological problems. What assumptions were built into the formation of pedigrees when they were used as research devices? Was it legitimate to consider these assumptions as given when the same pedigrees were used as demonstrative aids? How were the conventions of pedigree-drawing affected by their simultaneous usage for inner-scientific and popular purposes? And how did contrasting political and academic views affect the visual choices psychiatrists were making when addressing genealogical data? The paper will survey the changes in the usage of pedigrees by German psychiatrists from 1900 to 1933 and analyze the different graphical choices in both the German and the international context of hereditary research at the time. Special attention will be given to the implicit and explicit assumptions built into certain graphical choices and to debates inside the scientific community regarding these issues. Pedigrees are not the only case in which visual tools are used simultaneously to satisfy different goals: the same holds true for graphs of all sorts (e.g., in economics). German psychiatry nonetheless will serve as a useful case-study, which would enable the examination of interactions between socio-political motivations and scientific interests as manifested in the visual domain of scientific work.

Ari GROSS | University of Toronto, Canada

Inside and out: anatomical representations in public and specialized contexts

Many scientific and medical images require a significant level of training to understand, and are not therefore produced with the broader public in mind. There is, for example, little need to consider the non-specialist when producing a Feynman diagrams or chemical structural formula, since the audience of such images are likely to be practicing physicists or chemists themselves.

However, anatomical representations are noteworthy in that they are frequently viewed by non-specialists. After all, everyone has a body, and at various points in our lives many of us become increasingly curious about its structure. It is therefore no surprise, in the context of such a diverse audience, that the conventions that go into producing these representations differ from those found in more exclusive representations.

This talk will explore the structural and stylistic conventions regarding anatomical representations in the context of their multiple audiences. In examining anatomical atlases, wax models, and the plastinations used in the contemporary "Body Worlds" exhibitions, I will identify and discuss the graphical decisions involved in anatomical representations, and their epistemic consequences.

Eleanor LOUSON | York University, Canada

Simulated nature: wildlife films and the representation of animal behaviour

How do wildlife films represent organisms, and what are the consequences for our notions of nature and culture? I will argue that wildlife films are simulations: specifically, that their images of wildlife simulate organisms in the wild, species, and theories of wildlife behaviour. These simulations result in a perpetuation of established categories of nature and culture, which are promoted through this major popular medium. This narrated portrayal of wildlife, combining entertainment and education, feeds back on our conceptions of both

nature and human family values. This talk will break down the category of simulation into its multiple and overlapping dimensions of observation, experiment, and demonstration, employing examples from the history of the wildlife film genre. At this point I will distinguish between models and simulations, where the former stand in for phenomena while the latter act out the behaviour of phenomena; wildlife films are thus more appropriately simulations than they are models. I will consider the images of wildlife showcased in wildlife films as the components of simulations. This characterization holds both in terms of the interventions of "natural history artifice" (staging or fakery) throughout the history of the wildlife film genre as well as in non-interventionist filmmaking, which nevertheless simulates wildlife behaviour.

S036. Systems biology: a paradigm at work?

Wed 24 July, 09:10–12:40 ▪ Uni Place 3.205

Symposium organisers:

Karen KASTENHOFER | Austrian Academy of Sciences, Austria

Niki VERMEULEN | University of Manchester, United Kingdom

Symposium abstract

When the term 'systems biology' began to spread its wings within the life sciences around the turn of this century, the suggestion to introduce systems theory to biological research was not without antecedents. Among the acknowledged predecessors of current systems biology rank Norbert Wiener (as a founding father of cybernetics during and after World War II), Ludwig von Bertalanffy (and his coining of a 'General Systems Theory', developed between 1945 and 1968) and Robert Rosen (introducing 'Dynamical Systems Theory' to biology in the 1970ies). These scholars stand for an 'early' systems biology approach.

Moreover, the character of current systems biology is heavily influenced by recent historical developments. After a period of breakthroughs in molecular biology and the production of -omics data, a 'new' systems biology is currently being institutionalised via interdisciplinary research centres (e.g. in the US, the UK and Germany), the formation of collaborative networks on a national (e.g. HepatoSys and the Virtual Liver Network in Germany) and international level (e.g. within the EU funding initiatives SysMO and ERASysBio). This plural, multi-disciplinary and multi-national establishment of systems biology leaves many questions open which are commonly ignored in its characterisation as well as its historiography:

- How homogeneous is the 'new' systems biology? Should we speak of one systems biology or plural systems biologies when addressing current systems biology research?
- What was it that inspired 'early' systems biologies? Did they refer to or belong to (one or more) specific paradigm(s), thought style(s), communities of practice or socio-scientific constellation(s)?
- What are the relations between the 'old' and 'new' systems biologies? Are there any continuous traditions at the various local sites involved (like e.g. in Vienna)?
- Which are the varying ways of producing knowledge in a multi-disciplinary, multi-level approach (bottom-up, top-down, middle-out), where scientists work with multiple mediums (in silico / in vitro / in vivo)? Are there discipline-related heterogeneities?
- Are there local schools that account for diversity? Do different national modes of institutionalising and governing systems biology relate to different systems biologies?

- Is there a uniting aspect among current systems biologies? How could we characterise it? Is it a paradigm, a theory, a methodology, an approach, a set of practices or a discursive strategy?
- How are the various systems biologies positioned towards the ideal models of 'pure'/'basic' or 'applied' research? Is the differentiation between systems and synthetic biology requisite for such disciplinary identity work?

S036-A

Wed 24 July, 09:10–10:40 • Uni Place 3.205

Chairs:

Niki VERMEULEN | University of Manchester, United Kingdom

Karen KASTENHOFER | Austrian Academy of Sciences, Austria

Manfred DRACK | University of Vienna, Austria

Viennese school of systems thinking in biology

One of the core issues in biology is the organisation of parts and processes. How can it arise? How can it be dynamically maintained? How can it evolve? Three scientific giants worked on such questions in Vienna and came up with concepts and theories that lay the foundation for further fruitful research. Paul A. Weiss (1898–1989) performed experiments in developmental biology and neuroscience which entailed many system concepts that contradict a mechanistic understanding in biology. Ludwig von Bertalanffy (1901–1972) set up a theoretical biology, with a system approach at its centre. Rupert Riedl (1925–2005) took the system approach to evolutionary biology and provided explanations for the possibility and limitations of the arising of ever more complex order in living organisms. All three authors considered the whole – the system unit – to be at least as important as the parts for explanations in biology. They developed the system concept in different although connected ways. For all of them, the three-dimensional form was important. Key questions included how the morphological form changes in development and evolution and how this unit determines the parts. Microdeterminism, which refers to the idea that macroscopic phenomena are only determined by events on the micro- or molecular level, has to be complemented by macrodeterminacy (Weiss), which works in the diametrically opposite direction. This distinction points to the hierarchic arrangement of parts and processes in the organism – another basic concept. One question is how this hierarchy originates in development (Weiss, Bertalanffy) and evolution (Riedl). The modalities of influences in a system can be of different sorts; polytonic in the terminology of Weiss. Electric charge distribution, temperature gradients, chemical processes – all these modalities have to be considered. These and other concepts have been elaborated on by the three thinkers, who personally knew each other. The problem of organization, however, remains unsolved. This calls for further research in theory and praxis, research that also makes use of recent knowledge and tools. The talk focuses on the questions that the early thinkers wanted to solve and the approaches they used for that end. Whether this is related to a (new) paradigm or not, and whether it is in line with systems biology or not has to be discussed. [Research funded by the Austrian Science Fund (FWF): P22955-G17]

Bettina BOCK VON WÜLFINGEN | Humboldt-Universität zu Berlin, Germany

The top-down and bottom-up conflict in the history of inheritance

History of science assumes that 'the new' does not come into the world unprecedented. One of the fields in which the apparent conflict between models of more or less complexity have in the past two centuries been discussed in biology with most rigor much before the advent of systems biology and later became one of its major fields of application was

inheritance (later genetics and development/embryology and finally epigenetics).

This paper's point of departure is an analysis of models at the moment of the change from heredity to inheritance and genetics. It explores the relationship and potential parallels in the conflict of less complex, more static, mechanistic (bottom-up) models and non-mechanistic (top down) models in biology in the late 19th and early 20th century with the situation today. It does so along the example of inheritance, asking for the respective reasons and moral economy in the use of either concept.

The fundament for a mechanistic view on hereditary processes in organisms was introduced mainly by researchers in the German Empire in the 1870s to 1890s. Just as suggested by the organizers of this panel, here indeed 'place' or locality does play a role: the strongly reductionist account that separated material and function of the cell plasma and the nucleus from each other took shape on the background of prevailing idealism on site and a very specific historic situation in the German lands, which was the foundation of the Empire. This reductionism found its most serious opposition not only within its country but in the research by embryologists in the US, such as the early Thomas Hunt Morgan. However, as is well known in history of science, in the 1910s Morgan adopted a nucleocentric view on inheritance with the focus on chromosomal heredity, earning himself the reproach of being reductionist.

While discussing these changes between the 1870s and 1910s in comparison to current conflicts between reductionism, non-systems and systems accounts, the historical comparison shows that in the analysis of historical and today's models in biology it is not only useful but necessary to differentiate between different categories of reductionist or complex concepts: whether they are epistemological, methodological and ontological in many cases not only explains but solves the conflict.

Gabriele GRAMELSBERGER | Freie Universität Berlin, Germany

Towards a simulation-oriented biology: standardization and quantification

In a 2002 Nature paper systems biology was defined as the "mathematical concepts [...] to illuminate the principles underlying biology at a genetic, molecular, cellular and even organismal level" (Surridge, 2002, p. 205). During the past years these mathematical concepts have become 'whole-cell simulations' in order to observe and understand the complex dynamic behavior of cells. Already in 1997 the very first minimal cell was created *in-silico*, called the 'virtual self-surviving cell (SSC)', consisting of 120 in-silico synthesized genes of the 480 genes of *M. genitalium* and 7 genes from other species (Tomita, 2001). The virtual self-surviving cell absorbs up and metabolizes glucose, and generates ATP as an energy source for protein and membrane synthesis. SSC allows to observe the changes in the amount of substances inside the cell as well as the gene expression resulting from these changes, to study the temporal patterns of change, and, finally, to conduct experiments, e.g. real-time gene knock-out experiments.

However, the situation of modeling and simulation in cell biology is characterized by a wide variety of modeling practices and methods. There are thousands of simple models around, an increasing amount of simulations for more complex models, and various computational tools to ease modeling. Furthermore, quantitative data for initializing simulation runs are lacking. Thus, in order to establish a simulation-oriented biology, advanced methods of standardization and quantification are required. The release of the Systems Biology Markup Language (SBML) in 2003 and the Systems Biology Graphical Notation (SBGN) in 2009 are examples of such efforts for standardization as well as the development of time-based measurements, e.g. of high-throughput technologies for measuring changes in inner-cellular metabolites. The paper will first present an overview of the past developments for advancing standardization and quantification for 'whole-cell simulations'. It will

present the case of the *E-Cell* project (including the SSC) of the Laboratory for Bioinformatics at Keio University, initiated by Masaru Tomita. *E-Cell* not only aimed from very early on “to develop the theories, techniques, and software platforms necessary for whole-cell-scale modeling, simulation, and analysis,” (Takahashi et al., 2002, p. 64) but also strengthened the required infrastructure “for this new type of simulation-orientated biology, [...] by establishing] three centers for metabolome research, bioinformatics, and genome engineering, respectively” in 2001 (Tomita, 2001, p. 2). The paper, finally, will evaluate these developments from today’s perspective.

Sara GREEN | Aarhus University, Denmark

Going forward by looking back: learning from the history of systems biology

Even though systems biology is a new approach, it draws on theoretical and methodological approaches with a long and complex history. One of the important roots of systems biology is the earlier systems theoretic approaches that emerged in the mid-20th century. The concept of systems biology was used to describe a systems theoretic approach to biology already in the 60ies, but the ideas associated with the approaches did not initially become a part of mainstream biology. What makes them relevant for contemporary biology is that they in recent years have gained new thrust as a consequence of other developments such as the birth of functional genomics. A common goal for the earlier approaches and the new system theoretic stream of “new systems biology” is the search for *organizing principles*. These are general principles that apply to a class of systems despite the apparent differences of these systems, e.g. between artificial and biological networks, different species or different levels of organization. Organizing principles can thus be understood as robust generalizations that provide a deeper and more fundamental understanding of the behavior of a class of systems. Finding such principles remains a major challenge to contemporary systems biology and several systems biologists have called for new theoretical tools to focus the search for such robust generalizations.

In this paper I investigate the historical trajectories of the search for general principles of biological organization. I argue that more knowledge on the early systems approaches not only has the potential to improve our understanding of the current notion of organizing principles, but also can be important for future scientific developments within systems biology. Looking back can guide the development of new theoretical and methodological frameworks that draw on early systems approaches whose potential has not yet been fully explored. Furthermore, scientists may benefit from reflecting on the problems faced by earlier systems approaches in order to discuss the implications of the current modeling strategies. The talk will reflect on the heuristic value of the strategic search for organizing principles in general and the potential of earlier systems theoretical approaches in particular.

S036-B

Wed 24 July, 11:10–12:40 ▪ Uni Place 3.205

Chairs:

Niki VERMEULEN | University of Manchester, United Kingdom

Karen KASTENHOFER | Austrian Academy of Sciences, Austria

Karen KASTENHOFER | Austrian Academy of Sciences, Austria

How does ‘old’ relate to ‘new’? Epistemic cultures of systems biology in Austria, then and now

The ‘new’ systems biology is generally defined with reference to historical developments like the emergence of high throughput –omics data technologies as well as prominent historical antecedents, like Ludwig von Bertalanffy or Norbert Wiener, as proponents of an ‘old’

systems biology. It seems almost impossible to understand current systems biology approaches without these explanatory allusions. It therefore seems worthwhile to ask in how far the ‘new’ and ‘old’ approaches are actually linked beyond an (exoteric) explanatory function for the new field.

Based upon in-depth interviews with Austria-based scientists of different generations and documentary material covering the period in question, links between the Vienna-based work of Ludwig von Bertalanffy and the currently establishing field of systems biology in Vienna are delineated. The focus of this analysis lies on the epistemic culture of systems biology and its institutionalisation in Austria. (As for detailed analyses of Bertalanffy’s work, it is based upon the existing analyses by Drack and Pouvreau). It addresses rhetorical configurations as well as research practices and their interrelation. Moreover, it hints at more general shifts in the broader field of biology during the past century, especially the changing character of interdisciplinary configurations and the (diminishing) importance of local scientific traditions.

Niki VERMEULEN | University of Manchester, United Kingdom

Different styles of systems biology? Analysing local and national patterns of emergence

Over the last forty years biological sciences have undergone a revolution, as new techniques of analysis and information handling have produced masses of data on the key molecules in living cells. And although the concept of ‘systems biology’ has a longer history, the Human Genome Project and subsequent reductionist –omics projects, have given rise to ‘systems biology’ as a new trend in the life sciences where the focus shifts towards the integration of data on different levels, from (part of) cells to virtual organs and potentially whole organisms. After the establishment of the Institute for Systems Biology in Seattle and the Systems Biology Institute in Tokyo at the turn of the millennium, systems biology spread into national science policy programmes and became institutionalized in countries such as the United States, the United Kingdom, the Netherlands and Germany. This paper explicitly studies the entanglement of epistemic and social transformations in the emergence of systems biology, analysing new ways of doing research as well as the political and institutional structures in which the research is performed. Special attention will be given to different local and national patterns of emergence – from modeling yeast in Manchester to the creation of the German virtual liver. This research into the intellectual and social history of systems biology aims to help drafting the history of new biology and its relation to research policies, funding structures, university transformation, etc. in a way which can inform both academic and policy discussions.

Jane CALVERT | University of Edinburgh, United Kingdom

Systems biology, big science and grand challenges

Systems biology is currently one of the most prominent large-scale endeavours in the life sciences, so it might be considered to be a good example of ‘big science’. Further analysis shows, however, that although systems biology does make use of use of huge quantities of data, requires large amounts of funding, and is highly interdisciplinary and collaborative, in other respects it does not fit comfortably under the heading of big science. I suggest that we need to adopt new policy categories if we want to understand the dynamics of the contemporary life sciences. The term ‘New Biology’ has been used to identify recent changes. New Biology involves the integration of many different disciplines, and, importantly, it is oriented towards addressing major societal needs or ‘grand challenges’. I ask: if ‘big science’ was the language of the twentieth century, are ‘grand challenges’ the language of the twenty first?

Commentary: Sabina LEONELLI | University of Exeter, United Kingdom

S037. Cornucopia or Pandora's box: digital working methods, web portals and Virtual Research Environments (VREs) in the history of science and technology

Tue 23 July, 14:00–17:30 ▪ Uni Place 4.206

Symposium organisers:

Klaus STAUBERMANN | National Museums Scotland, United Kingdom

Heiko WEBER | Göttingen Academy of Sciences and Humanities, Germany

Symposium abstract

Latest in the first decade of the 21st century, the World Wide Web has become an indispensable resource for historical studies. Not only has it become the standard means of communication and of text productions, it also provides access to historical sources in a hitherto unimaginable, simple and comprehensive way. Moreover, digitised sources become available to electronically supported analysis.

With our own eyes we can observe the development of a new kind of technology-usage in particular scientific and technological communities of today. Digital versions of printed material, manuscripts, and electronic media (e.g. broadcasting) are supplied in an unprecedented quantitative dimension by large scale projects such as Internet Archive and Google Books and by digitisation projects of important libraries. They take the study of communication about science to a new level. This cornucopia poses the challenge of coping with a huge number of documents. Digital research environments and thematic web portals can supply the necessary tools for searching, comparing and visualising these data and for their quantitative and linguistic analysis. In doing so, they help to address and cast new light on relevant issues in the history of science, e.g. the creation, dissemination and deployment of knowledge and practice across all periods. This opens new possibilities for the observation of 'science at work'.

Yet, the new powerful digital instruments, if applied blindly, might turn out to be a Pandora's box. The way science works in a digital environment itself deserves close examination, because it affects the status relations of technology and scientific work. Therefore digitisation is, in our view, not only a research instrument. It is also an important object of research, because of its considerable impact on the ways how knowledge works.

How the potential of digital media, tools and working methods can generate new research questions needs to be discussed in this context. This question, among other issues, has been scarcely noticed until now as well as it can contribute substantially to the history of science, technology and medicine.

Accordingly our symposium will unite six state-of-the-art web, Virtual Research Environment and digitisation projects on cultural heritage and historical documents. Each stands for a special type of material, method of presentation or research question in the history of science, technology and medicine. Rooted in different national academic cultures, these projects may also show if and how national styles and strategies have developed in the use of the new medium 'internet' for scientific work.

S037-A

Tue 23 July, 14:00–15:30 ▪ Uni Place 4.206

Chair: Heiko WEBER | Göttingen Academy of Sciences and Humanities, Germany

Claudia KROKE | Göttingen Academy of Sciences and Humanities, Germany

The works of Johann Friedrich Blumenbach: an online edition for the 21st century

"Johann Friedrich Blumenbach – online" is a long-term project financed by the Union of German Academies of Sciences and is based at the Göttingen Academy of Sciences and Humanities (<http://www.blumenbach-online.de>).

The project entails, among other things, an internet edition of Blumenbach's published writings including translations and reissues, enriched by digital images from objects of natural history.

Johann Friedrich Blumenbach (1752–1840) was Professor of Medicine and Natural History at the University of Göttingen. One of the leading exponents of the revolutionary change of the geo-biological concept of the world at the turn of the 18th to the 19th century, his long life bridged the biology of Carl von Linné on the one hand and Charles Darwin on the other.

In his famous classification of human varieties, Blumenbach coined the term "caucasian" which is used today in the English-speaking parts of the world to denominate Europeans and light-skinned people. From the mid-19th century onward, Blumenbach was misunderstood as fathering the idea of scientific racism, when in fact he urged for the unity of humankind, thus becoming the founder of scientific anti-racism.

The presentation will give an overview of the challenges the electronic editing of an 18th-century, multi-lingual, multi-topic, multi-media corpus poses. Important decisions need to be made in advance as well as along the way, concerning e. g. a) the implementation of standards to ensure interchangeability, b) the level of markup required to yield high quality results and keep the texts reusable in new/different scientific setups, c) connecting the findings to the encyclopaedic knowledgebase of the internet. The constraints ensuing from this concept will be addressed as well, for example the limitations of using ID-numbers from an online-thesaurus opposed to the freedom of formulation possible in traditional editing practice.

The presentation will show how only an electronic edition can render a detailed and visualisable analysis of the structure of Blumenbach's work, making evident the evolution and dissemination of ideas and texts over time and generating new avenues for future inter- and multi-disciplinary (history of science, anthropology, zoology, botany, geology, chemistry, archaeology, ethnology, philosophy, history, etc.) research.

Ursula ZÄNGL | German National Library of Medicine, Cologne, Germany

Digitization projects of the German National Library of Medicine, Cologne, with special emphasis on 'physical anthropology'

Among the special subject collections of the German National Library of Medicine, Cologne, is physical anthropology, a field of research that became an academic discipline subject only in the 19th century. The body of specialized literature on Physical Anthropology is comparatively small and can be well defined, thus offering good preconditions for its retrodigitization. Different types of sources are involved, including printed publications as well as research data in the form of manuscripts, notes, letters, drawings and sketches.

The retrodigitization project started by the ZB MED aims at the preservation of printed works and handwritten material concerning physical anthropology and to make these documents available for research. For this purpose, it will provide scientists and scholars with an access point for studying and analyzing them, build a database for all kinds of images and enrich these data with historical material from other institutions, e.g. archival documents and letters. The emphasis will be on

the estate of two eminent 19th century academics: Hermann Schaaffhausen (1816–1893), professor at Bonn university and the first to identify and describe the “Neanderthal man”, and the Berlin physician and pathologist Rudolf Virchow (1821–1902), who was Schaaffhausen’s opponent in scientific matters.

The ZM MED will also make sure that valuable parts of its holdings from other disciplines are likewise preserved by digitization and enriched with documents from other institutions. In this context, we are aiming at establishing a network of cooperation between libraries, archives and museums.

The presentation will discuss strategies for handling research data from the field of physical anthropology that are to be stored electronically, e.g. which problems arise in the process of retro digitization, and how these data can be made available in an online portal. The already existing “Digitale Sammlung” of the ZB MED (<http://s2w.hbz-nrw.de/zbmed>) will serve as an example for demonstration. The focus will be on the integration of research data obtained from cooperative partners, on the development of relevant metadata and on search options in the database.

Simone RIEGER | Max Planck Institute for the History of Science, Germany

Urs SCHOEPFLIN | Max Planck Institute for the History of Science, Germany

ECHO – Cultural Heritage Online: an open access research environment and publication models for the humanities

Access to cultural heritage on the Internet is often restricted or limited in scope, and the overall availability is still inadequate for scholarly needs. Based on an initiative from several Max Planck Institutes in the Humanities, “ECHO - Cultural Heritage Online”, (<http://www.echo-project.eu>) - makes freely and openly available a wide scope of materials pertinent to cultural heritage covering 5.000 years of documented human history and including ancient documents, rare books and museum objects. At the same time, the repository offers appropriate open source tools to allow for scholarly work with these digitized resources and for integrating sources, on-going research, and dissemination of results in a workbench for humanities’ scholars.

The current holdings summary of ECHO lists more than 1000 source authors in 80 collections and several disciplines and thematic fields, 880,000 high resolution images of historical and cultural source documents and artefacts, over 240 film sequences of scientific source materials, and more than 57,500 full-text page transcriptions in several languages. The ECHO network includes more than 170 institutions from 24 countries worldwide as active knowledge weavers.

The basic principles of ECHO and the underlying concept of a scholarly workbench for the humanities will be explained on behalf of examples of source materials which have been collaboratively digitized, transcribed and made available in cooperation of the Max Planck Institute for the History of Science (MPIWG) and other scientific institutions. Special attention will be given to the development of tools addressing scholarly use needs that only now uncover the full potential of open access to digitized sources by opening up new ways of addressing research questions and that have the capability to fundamentally change the basis of humanities’ scholarship.

In the digital age the medium Internet and advanced technologies allow for fast and easy to use solutions for working with extensive corpora of knowledge in a global network of scholars as well as for innovative platforms for rapidly disseminating scholarly content.

S037-B

Tue 23 July, 16:00–17:30 ▪ Uni Place 4.206

Chair: Klaus STAUBERMANN | National Museums Scotland, United Kingdom

Irene RABL | University of Vienna, Austria

Two Benedictine historians go online: the digitized papers of the brothers Pez, OSB.

In 2008, a research group began work on FWF Start Project “Monastic Enlightenment and the Benedictine Republic of Letters” at the History Department of the University of Vienna and the Austrian Institute of Historical Research. The research design of the project is centered around the learned correspondence of two Benedictine monks from the Lower Austrian abbey of Melk, Bernhard (1683–1735) and Hieronymus Pez (1685–1762). The brothers Pez were among the first scholars in the Catholic South of the Holy Roman Empire to systematically collect and critically publish medieval manuscript sources, including many from monastic libraries which have since been dispersed or lost. Beyond the letters to the brothers Pez, the archives and library of Melk Abbey in Lower Austria contain large quantities of manuscript material left by them, both their own notes and the submissions of their correspondents. This includes, for example, various types of biographical lists, (partial) catalogues of books and manuscripts for numerous libraries, excerpts and transcripts from medieval manuscripts and charters. This material assembles the knowledge possessed by the brothers Pez and by their contemporaries, including much information taken from sources that have since been lost or libraries that are now dispersed. Between 2009 and 2012, the Pez papers were digitized, provided with the necessary metadata and imported into Unidam, a digital asset management system hosted by the University of Vienna. The ca. 50.000 images (1,5 terabyte) represent the content of eleven archive boxes and 58 manuscripts and are accessible on the internet.

The digitized Pez papers and the “traditional” publication of the Pez letters act as complementary sources for each other: the information gathered for the publication of the letters complements the database, which, on the other hand, not rarely provides the only key for a proper understanding of the letters. This illustrates the mutual benefit of traditional and digital approaches to source publications.

Access to the database:

http://www.univie.ac.at/monastische_aufklaerung/en/digital-pez-papers.

Klaus HENTSCHEL | University of Stuttgart, Germany
Torsten HIMMEL | University of Stuttgart, History Department, Section for History of Science and Technology, Germany

DSI: the Stuttgart database of scientific illustrators, 1450-1950

A new online database on scientific illustrators (DSI) compiled at the section for history of science and technology of the University of Stuttgart will be portrayed in its main features. The DSI lists illustrators of scientific publications of all genres (esp. atlases, articles, textbooks) who were active between 1450 and 1950, thus excluding illuminators of medieval manuscripts as well as illustrators still active. We have now reached 4900 entries (as of Feb. 28, 2013) and plan to get to 6000 entries by mid-2012. Currently DSI still puts particular emphasis on anatomy and dermatology, astronomy, mineralogy, botany, zoology and general natural history, but other fields such as geology, chemistry and physics will also be included. Access to the database with its 20 search fields is free and open to all interested users at

www.uni-stuttgart.de/hi/gnt/dsi/

with links to a separate search window, a list of our main sources, contributors etc. We also created a subpage where you can send us data on missing illustrators or supplement existing entries with additional information.

Why do we currently compile such a database? The reason is that existing compendia such as Thieme-Becker, Benezit or Bryan’s mostly feature “artists” catering to the art market and claiming to produce true

“art,” even though such claims by graphic artists in the print and photographic media were contentious for quite some time. Most illustrators of scientific works do not meet this criterion and thus many of them are not covered in existing reference works. They fell through the cracks. Historians of art did not consider them “genuine” artists, while in the past historians of medicine, science, and technology often deemed them mere aids or handymen for their biographical key subjects: the scientists. The meagre state of knowledge about many of these commissioned draughtsmen, engravers, etchers, woodcutters, painters, colourists, lithographers, photographers, and other illustrators has long been known and has often been deplored. Yet little has been done to redress it. This we would now like to change. Modern media permit an entirely new, prosopographical approach by surveying their education, careers and family ties, patronage and clients, their regions of activity, archival and secondary sources on each of them etc. This allows us to gain a deeper understanding of this important group of individuals and, in so doing, develop a greater grasp of scientific practice and of their intricate social networks of family ties and collaboration. We will focus on the search options open for all now, but a few preliminary conclusions on these clusters and networks from our ongoing research will also be presented.

Carlene STEPHENS | Smithsonian Institution, United States

Digital revival: recovering and preserving the earliest sound recordings

Staffers at the Smithsonian’s National Museum of American History are working with partners at the Library of Congress (LC) and Lawrence Berkeley National Laboratory (LBL) to recover sound from some of the earliest sound recordings ever made. These recordings, made in Alexander Graham Bell’s Volta Laboratory between 1881 and 1885, were considered unplayable until LBL partner Carl Haber and his associates invented a noninvasive process about 2003. Without ever touching the fragile recordings, the process employs ultra-precise measurement instruments and results in digital .wav files.

This presentation describes the ongoing project, reports on results to date, and offers preliminary thoughts about the project’s implications for sound preservation and studies of sound culture.

S038. “A work to be done”: the manual and the cognitive in early-modern science

Sat 27 July, 14:00–17:30 ▪ Uni Place 4.204

Symposium organisers:

Fokko Jan DIJKSTERHUIS | University of Twente, Netherlands

Sophie WEEKS | University of York, United Kingdom

Symposium abstract

Francis Bacon codified what the later seventeenth century termed “experimental philosophy.” The success of Baconian reform required the union—Bacon calls it the “marriage”—of theoretical (or speculative) inquiry and an essential operative, or hands-on, approach. Incorporating “hands-on” as an equal partner in natural inquiry requires work, money, and time. In the aspirations of early modern experimental philosophers, the term “work” has a triple meaning. First, it registers the manual nature of experiment and the operative nature of the new knowledge. Second, it highlights the aim of this novel and hybrid approach to nature, viz. the production of works, that is, inquiry is given a utilitarian sanction. Third, to bring about the novel combination of contemplative and operative pursuits required great efforts—intellectual, practical and social. Thus, the term “work” covers the entire nexus of activities requisite for

productive power. As a consequence, experiment itself takes on a hybrid existence between labour and leisure. The Baconian marriage signals a cultural shift where those actively pursuing natural philosophy become “working scientists.” Knowledge, effort, materials, tools, instruments, time and money are the essential ingredients of the new experimental philosophy. In the absence of these activities, mere philosophical (contemplative) claims about nature were considered chimerical, barren and time-wasting. In view of this emphasis on work and utility, the experimental philosophy faced several major obstacles. The first is evident in the term itself: “experimental philosophy” is a paradigmatic oxymoron formed out of the hitherto contradictory elements of manual work and contemplative philosophizing. Then, quite apart from methodological and theoretical criticisms, this hybrid enterprise could not avoid the social stigma of dirty hands and sweaty labour plus exorbitant expenditure of time and money. Also, not everyone possessed the necessary qualities, expertise, motivation and time to carry out the work, which could spread itself over many sites and command diverse skills. Through emphasizing the oxymoronic character of experimental philosophy, we bring a novel approach to the emergence of early modern science by problematizing the marriage of reason and experiment. Early modern virtuosi had to work at the marriage of experiment and philosophy. To avoid what Bacon termed “an inauspicious divorce” and to ensure a marriage productive of works, they had to overcome social and cultural tensions and seeming epistemic contradictions. Our symposium considers key seventeenth-century figures such as Bacon and Boyle as they struggle to overcome these tensions, up to eighteenth-century efforts on the part of Tschirnhaus, Franklin, Priestley, Cavendish and Hutton to respond to the challenges of experimental philosophies.

S038-A

Sat 27 July, 14:00–15:30 ▪ Uni Place 4.204

Chair: Steven A. WALTON | Michigan Technological University, United States

Friedrich STEINLE | Technische Universität Berlin, Germany

How to learn from experiment: the case of early-modern electricity and magnetism

Using experiments to draw philosophical lessons has a long tradition in physiology, in optics, and particularly in chymistry where its practitioners addressed the epistemic status of experimental results already in the fourteenth century. The Early Modern emphasis on experiment by Bacon and his fellow protagonists could and did build on existing traditions, mostly without mentioning them, however. The aim of my contribution is to point to those traditions in the history of knowledge of magnetism and electricity. Starting with the thirteenth-century work of Peregrine as an exemplary case of a combination of philosophical magnetic knowledge and experimental approach, I shall focus on the sixteenth century, with authors such as Cardano, della Porta, and Garzoni who drew from most various resources, including own experiments, to widen their knowledge of magnets and of the peculiar effects of rubbed amber. When Gilbert, in his 1600 monumental *De Magnete*, provided both synthesis, essential abstractions, and philosophical explanations, he drew not only on existing knowledge, but also on existing approaches of how to enlarge it. In my talk, I shall try to work out essential points of those traditions, and to evaluate Gilbert’s claims of novelty against that background. More generally, this will shed light on the character of the programmatic statements of experimental philosophy.

Sophie WEEKS | University of York, United Kingdom

All work and no play: Francis Bacon’s new method

Although Bacon himself did not coin the term ‘experimental philosophy’, it was he who devised a new method to bring about the union of the experimental and rational faculties. The distinction between speculative

and experimental philosophy also has its origins in Bacon. Unlike the method of the empirics, both speculative and experimental philosophy utilize the powers of the mind. However, Bacon rejects the speculative philosophy of the scholastics because it relies solely on the mind, and more specifically the imagination. He characterizes the *modus operandi* of the imagination as 'play' (*lusus*) because it is free to do as it pleases and 'to make up' (*ingere*) whatever it likes. And because the mind is altogether divorced from reality, scholastic philosophy is thus nothing but a delusion, a figment of the imagination. The Baconian method, by contrast, does not depend solely or even mainly on the powers of the mind. To ensure that knowledge has a basis in reality, Bacon tethers the mind to nature in an 'enduring marriage.' Through the exteriorization of the function of reason in the form of tables of comparison, Bacon's new method definitively excludes any interference by imagination in the processing of the relevant data. Instead, the mind is subjected to extreme discipline and forced to 'buckle down' to work on the data in the tables. In contradistinction to the speculative philosophy, the Baconian experimental method is all work and no play. Knowledge and power over nature can only be acquired through hard labour. All science, says Bacon, is the mind's 'exercise and work' (*exercitatio & opificium*).

Chris KENNY | University of Leeds, United Kingdom

A 'drudge of greater industry than reason': Robert Boyle's experimental philosophy

Experimental philosophy was a product of Bacon's radical reform of natural inquiry. Baconians such as Robert Boyle regarded experiment as a necessary condition for the philosophical discovery of material causes. A usually decorous Boyle gladly joined in the ridiculing of traditional natural philosophy as an unremittingly discursive pursuit, whose glaring failure was its complete lack of contact with nature. Experimenting, however, entailed labour in the laboratory. Boyle was an aristocrat, yet manual work was associated with dependency and servility. According to Nathaniel Highmore, Boyle did not accept that his 'blood and descent' might be jeopardized because he was 'married to the arts', that is, to the mechanical and chemical arts – enterprises demanding a direct hands-on approach. While Highmore's comments suggest that Boyle was no more averse to manual toil than he was to intellectual sweat of the brow, Steven Shapin argues cogently that it probably was not Boyle who got his hands dirty. On Shapin's analysis, 'technicians' laboured while Boyle philosophized. Was this division of labour in keeping with the Baconian method, grounded as it was on the union of the manual and the cognitive? What difference does it make for Boyle's efforts at realizing experimental philosophy if he did not in fact engage in the manual labour of experiment? This paper considers how Shapin's division of labour can be reconciled with Boyle's Baconian programme for 'the happy Marriage, or combination' of theory and practice.

Catherine FRANCE | University of Leeds, United Kingdom

'Causes, not experiments': The internal work and the external face of the Accademia del Cimento

For a short period (1657-1667), the Cimento Academy based at the court of Galileo's patron Prince Leopold of Tuscany, was a pioneer in the experimental method in science. There has been a revival of interest in the Academy in recent years, but this attention has if anything increased contention over the nature and purpose of the Cimento's activities. Historians of science have taken contradictory stances, thus illustrating the problematic of the experimental philosophy, which took on 'a hybrid existence between labour and leisure'. This paper focuses on a series of experiments with guns carried out by the Academy in 1662 and included in its only publication, the *Saggi di naturali esperienze*. These experiments serve as a vehicle to investigate the dynamic between the working engineer, the experimenter and the theoretician that became an integral part of the Medici state enterprise in this period.

S038-B

Sat 27 July, 16:00–17:30 • Uni Place 4.204

Chair: Steven A. WALTON | Michigan Technological University, United States

Jean-Francois GAUVIN | Harvard University, United States

Organum, habitus, museum: early modern instruments in context

What did Francis Bacon mean in his 1620 *Novum Organum* when he proclaimed that he had "supplied the Instrument (*Equidem Organum probui*)" to solidly found philosophy and the sciences on every kind of experience? What did René Descartes mean when he wrote to Mersenne that his *Discours de la méthode* consisted "more in practice than theory" and to princess Elisabeth that in order to always be prepared (*disposé*) to judge well, one needed two things: the knowledge of truth and the habit (*l'habitude*) of remembering and recognizing this knowledge every time one stood in front of it. Why did David Hume's philosophy of knowledge relied so heavily upon habit, or custom? So much so that without customary conjunction there simply was no knowledge of the world? These abstract early modern "instruments" were as much dependent on practical habits (or practical schemes) as were material instruments—such as the telescope, the air pump and a plethora of mathematical instruments. In this paper I want to explore (I should perhaps say follow) the trajectories of these diverse objects: what define them as instruments (*organum*), how distinctive practical habits (*habitus*) were for each instrument, and finally how should we reconcile these early modern instruments and practices with our vastly different intellectual and cultural contemporary context (*museum*). There exist a widening gap between the production of scholarly works on scientific instruments and their showcasing in brightly lit and decontextualized museum spaces. The questions are twofold: why care? And how to bridge this gap? Mapping the trajectories between early modern instruments and today's museums may actually compel us to look back at these objects and reevaluate our understanding of their inner practical and operational attributes.

Fokko Jan DIJKSTERHUIS | University of Twente, Netherlands

Materials of light, reasons of light: Tschirnhaus's glass works from the 1680s

From the 1680s Ehrenfried Walther von Tschirnhaus (1651-1708) developed intricate optical instruments to focus and employ the power of light. Starting out by improving the construction of burning mirrors and the analysis of caustics, he went on to make the most powerful burning lenses of his day that promised the transmutation of materials - for some. Over the course of his pursuits Tschirnhaus interacted with savants like Huygens and Leibniz, who responded with searching mathematical, physical, and philosophical queries regarding the properties of his optical instruments. What worked practically was not necessarily reasonable. At the same time, he engaged with diverse efforts to put the power of light to practical use in industrial projects of material manufacture. Eventually, his burning lenses gave rise to a heated dispute over the nature of light and its possibilities to produce chemical reactions. This intricate web of practical and philosophical confrontations brought together diverse minds and interests, giving rise to the question what scientific use the material successes of his burning lenses may have. This issue of the proper way of putting science to use not only occupied Leibniz; Tschirnhaus himself too reflected on the nature and value of experimental philosophy.

Marieke HENDRIKSEN | University of Groningen, Netherlands

Quicksilver doctors: mercury in eighteenth-century laboratory practice and medical theory

Quicksilver and quicksilver-based drugs were widely used as cure-alls throughout the seventeenth and eighteenth centuries. This paper is concerned with the question how mercury, as an alchemical material, remained integrated in eighteenth-century medicine. It is based on the hypothesis that even though alchemy itself became increasingly

associated with deceit, alchemical materials remained of crucial importance in medicine, and that the integration of chemical experiment in academic medicine strengthened the position of mercury in medical theory rather than undermining it.

Mercury was commonly seen as a life-giving substance that could penetrate and cleanse even the smallest structures in the body, and hence as a powerful drug. Mercury-based drugs were widely used to treat venereal diseases, skin problems and general physical imbalances. However, mercury was also known to be potentially dangerous, and was associated with quacks and gold-seeking alchemists. Nonetheless, practical chemistry – taking most of its methods and materials from traditional alchemy – was steadily integrated in academic research and teaching from the seventeenth century, and experiment and reason were increasingly combined to develop medical theory.

Curiously, this does not seem to have changed the use of mercury in medicine considerably, as mercury-based drugs were still found in abundance in early nineteenth-century pharmacopeia and medicine chests. The continued use of mercury in drugs reveals the tensions surrounding the eighteenth-century use of mercury. On the one hand traditional transmutational alchemy was dismissed by someone like the famous professor of chemistry and medicine Herman Boerhaave (1668–1738) and ridiculed by his follower Abraham Kaa Boerhaave. On the other hand, mercury was still considered one of the most important medical materials. This paper considers how eighteenth-century laboratory practice influenced the role of mercury in contemporary medical theory.

The focus here is on Leiden University, where a chemical laboratory was first installed in 1669, and where Boerhaave experimented with mercury extensively in the 1730s. This paper shows how the results of these mercury experiments in the eighteenth-century academy were integrated in academic medical theory, and investigates whether this actually changed the use of mercury in drugs.

John CHRISTIE | University of Oxford, United Kingdom

Experimental and speculative work in eighteenth-century Britain: Franklin, Priestley, Cavendish and Hutton

The natural sciences in eighteenth-century Britain displayed a devotion to experimental prosecution of what Kuhn referred to as the newly experimental 'Baconian' sciences (electricity, magnetism, heat, chemistry), but also and equally to speculative theorising concerning the causal processes which underlay the often puzzling, even baffling, behaviour of the phenomena revealed by experiment. This paper takes examples from the work of key eighteenth-century figures in order firstly to emphasise the increasing diversity covered by the term 'experiment', and secondly to assess which modalities of experiment might be held to exhibit an *echt*-Baconian character. It proceeds to examine the speculative dimensions of these examples, insisting upon a comparable diversity, not primarily of theory-content, though that is of course present, but of epistemic dispositions with respect to theoretical speculation itself. Recognising these diverse modalities in our key terms is a necessary prerequisite, it is held by way of conclusion, to historical understanding of the kinds of work exhibited in our exemplars, and of the meanings such integrative work had for its practitioners.

S039. Literary history and the history of science

Wed 24 July, 11:00–17:30 • Uni Place 4.206

Symposium organisers:

Janine ROGERS | Mount Allison University, Canada

Michael WHITWORTH | University of Oxford, United Kingdom

Symposium abstract

Considerations of literature and science are often historically determined, and this symposium will consider how knowledge-making and practice in the fields of literary and scientific history work, or don't work, together. Its three sessions will explore the relations of literature and science at three different levels – the institutional, the verbal, the formal – and will conclude by considering historicism in relation to the field.

(1) Scientific Institutions and Literary Culture.

This session asks how scientific institutions have engaged with literary knowledge in their activities and their publications and about the place of these institutions in their contemporary literary cultures. We have identified potential speakers on The Royal Society, The Royal Institution, and The British Association for the Advancement of Science; we would have an open call for papers with a particular focus on Lit. and Phil. Societies in North America and Europe.

(2) Literary Knowledge, Scientific Knowledge, and Literary Form.

This section focuses on the exchange between structural and formal models of knowledge in science and literature. It will interrogate the relationship between literary poetics, including codicological, rhetorical, figurative, and linguistic forms, and the poetics of scientific spaces, including collections and museums. How has literary knowledge shaped other knowledge forms, especially the scientific? How has science shaped literary form and literary language?

(3) Historicism in Literature and Science.

This session turns to the relation of history of science to historicist literature-and-science studies. What is the authority of historicism in literature and science? What benefits does the rigour of the history of science bring to the field, and what price must be paid? What are the costs and benefits of chronological precision?

S039-A. Scientific institutions and literary culture

Wed 24 July, 11:00–12:30 • Uni Place 4.206

Chair: Janine ROGERS | Mount Allison University, Canada

Sharon RUSTON | University of Salford, United Kingdom

Chemistry and poetry at the Royal Institution of Great Britain

Humphry Davy's lectures to the Royal Institution were hugely successful, attracting large audiences of women as well as men. Among the audience were literary figures, including William Godwin, Robert Southey, and Eleanor Anne Porden. S. T. Coleridge, who apparently attended an entire course of lectures in 1802, wrote copious and beautifully-written notes in these lectures, which give us a sense of which aspects were of interest to him and of the immediate experience of being in Davy's audience. In turn, Davy persuaded Coleridge – after some delay and procrastination – to give lectures in 1807 on the subject of poetry. These were not the only lectures given on non-scientific subjects in R. I., Sydney Smith also lectured on moral philosophy; William Crotch lectured on music; William Crowe, Thomas Campbell, James Montgomery and others on poetry. The library of the Royal Institution, as can be seen in its catalogue of books, holds an extensive collection of literary as well as scientific texts. There is also extant poetry in the R. I. archives written on the subject of Davy's lectures by admiring female fans. Coleridge in later lectures made the connection between his own and Davy's lectures, pointing out that his were originally given 'in the spring of the same year, in which Sir Humphry Davy, a fellow-lecturer, made his great revolutionary discoveries in chemistry'. In this paper I explore the role that the Royal Institution had in the literary culture of the time as well as the role that literature had on the scientific culture of the R.I.

Katherine FORD | University of Reading, United Kingdom

The Royal Society fellows, the *Philosophical Transactions* and communicating science in the nineteenth century

The Royal Society was founded in 1660 and the place it holds in literary and popular culture has evolved over time. Here I will focus on the nineteenth century as a time of transition for the Royal Society, its Fellows and society's attitude towards science itself; coming at a time when print media was increasingly accessible. I will examine the way in which the Fellows shaped this new attitude towards science through their writing and the ways in which they both engaged the public attention while, often simultaneously, making it more difficult for the non-scientist to engage with them.

Many of the Society's Fellows were instrumental in the promotion of popular science and the professionalization of science. The influence of literature enabled them to communicate better, making their writing and their lectures more accessible and more engaging to a wide audience. However, the same scientists were making science a closed subject by the sheer breadth of their investigations. Scientific language was often high impenetrable, and there is a tangible difference in the way scientists wrote for a general audience and for a purely scientific audience. Nowhere is this more evident than in the Society's primary scientific publication, the *Philosophical Transactions*, and by comparing the works published here with popular science writing by Fellows on the same subjects, we can see the difficulties posed in this alliance.

The influence on literature is difficult to trace, especially considering there do not seem to have been very many direct links between the Royal Society and literary figures. The topics written about in the *Philosophical Transactions*, though, would have filtered through to popular culture and become apparent in literature. Here I will trace briefly the path of chemistry through the *Philosophical Transactions*, into popular understanding and through to literature; whether it has been accurately portrayed or manipulated in some way, and indeed, if the way the topics were used in literature impacted on their presentation in the publications of the Royal Society.

The Royal Society and its Fellows were instrumental in creating a closed book in the exponentially expanding language of science, whilst simultaneously seeking to spread knowledge. Some topics were more popular for audiences and writers than others – but was this due to the Society, its Fellows or the taste of the author; and how far did the influence extend both ways?

Commentary: Janine ROGERS | Mount Allison University, Canada

S039-B. Literary knowledge, scientific knowledge, and literary form

Wed 24 July, 14:00–15:30 ▪ Uni Place 4.206

Chair: Charlotte SLEIGH | University of Kent, United Kingdom

Janine ROGERS | Mount Allison University, Canada

Codicology: the medieval codex and early science collecting activities

At the heart of early collecting activities and the development of the science museum is an ethos of collection reaching back to medieval manuscript culture. As Paula Findlen and James J. Bono have explored, the history of museums and the history of book culture share a language and a philosophy; I argue that these shared traits are rooted primarily in the management of physical space – on the page and in the collection cabinet and museum. In the 'age of the compiler' (M.B. Parkes) from the

thirteenth century on in the middle ages, the assembly of texts in books was highly theorized. The medieval theory of authorship attributed all textual activity to theological – and therefore cosmological – realms. Text for the medievals was quite literally the word of God, the ultimate *auctor* or author; by extension the management of text on the page was a theological and philosophical activity. For professional bookmakers, especially ecclesiastics, bookmaking work was discussed as two interlocking activities – *compilatio* and *ordinatio*. Museums, collector's cabinets and other structural spaces of material culture actually refer back to earlier codicological models – specifically, the medieval manuscript and its illuminations – and the visual syntax of these images speaks directly to a text-based philosophy of collecting from the middle ages. This paper explores medieval theories of book production as they are seen in early science collecting and museum-making. I will discuss the wider implications of codicological models for scientific cultures and the creation of 'codicology', the construction of scientific models and ideas of the cosmos underpinned by medieval book theory.

Renata SCHELLENBERG | Mount Allison University, Canada

Curious connoisseurship: Goethe's collection of nature

Goethe was a well-known collector of natural specimens and man-made artifacts. In both cases his method of collecting was based on principles derived from his scientific studies in which he sought to organize phenomena mimetically, according to their observed presence in nature. By grouping phenomena together in such a manner he believed capable of displaying a natural order, one in which the phenomenon itself "spoke", revealing its relationship to and connection with other phenomena. Drawing on scientific practices of the day, Goethe used taxonomies as the disciplined means of visualizing the underlying interconnectedness of the natural world, employing sequence as a way of offering coherence to the specimen in his collections. The perception he developed through collecting proved to be beneficial to his studies on morphology and physiology.

Goethe's mode of comprehensive classification posed, however, a serious challenge to traditional forms of scientific expression, as well as to the nomenclature of collecting itself. The emphasis he placed on the interrelationship of phenomena made his collections a framework in which a dynamic, rather than any particular phenomenon was to be studied, creating a display that was constantly in flux and impossible to encapsulate by linguistic means alone. The protracted attention required to view phenomena in the proper fashion was defined by critics as *gegenständliches Denken*, a thought that does not merely delight in observation, but that actively seeks to connect and elucidate in order to garner true meaning.

Michael WHITWORTH | University of Oxford, United Kingdom

Scientific language and the form of modern poetry

This paper will ask what modern poetic form does to scientific discourses, and what the presence of scientific terms in poems does to and for those poems. It will ask how – and how far – we can bring the history of science to bear on the interpretation of the poem, and how far its qualities as poetic discourse remove it from historical questions. The poems examined will date from approximately 1910 to 1975. 'Form' for the purposes of this paper is the gestalt of an individual poem, rather than fixed forms such as the sonnet or the villanelle. While effects of rhyme and prosody may affect the significance of a scientific word within a poem – as for example with 'etherised' in the opening lines of T. S. Eliot's 'The Love Song of J. Alfred Prufrock' (1917) – what looms larger in the post-1900 period is the relation of kinds of discourse and the ironies created through incompatible perspectives. The discovery of the poetic potential of scientific discourse was set in motion by Eliot's valorisation of the seventeenth-century metaphysical poets, with the extended metaphor being foregrounded. The paper will discuss modernist and neo-metaphysical poetry by poets such as Mina Loy,

John Rodker, Herbert Read, Michael Roberts, William Empson, and C. Day Lewis. In their works, scientific vocabulary is often represented by a small number of significant words, and the slightness of its presence raises the question of how far vocabulary can imply the presence of discourse; it raises the question of the readerly work needed to reconstruct the underlying concepts. Standing in contrast to these poets is the Scottish modernist Hugh MacDiarmid, whose strategy was one of appropriation (alternatively dubbed 'plagiarism') of much longer passages from prose, including specialist and popularising science writings and book reviews. MacDiarmid's approach is interesting for the contrast it creates, and significant for its anticipation of later twentieth century 'late modernist' or 'linguistically innovative' poetries.

Commentary: [Charlotte SLEIGH](#) | University of Kent, United Kingdom

S039-C. Historicism in science and literature

Wed 24 July, 16:00–17:30 • Uni Place 4.206

Chair: [Michael WHITWORTH](#) | University of Oxford, United Kingdom

[Charlotte SLEIGH](#) | University of Kent, United Kingdom

Too much of a good thing? Historicism in literature and science

This paper re-treads some of the shared terrain of literature, history and science scholarship of the past generation. Lit & sci studies – at least those in the UK – are increasingly historicist in character, so much so that they are at times indistinguishable from historiography. At the same time, historians of science have discovered the history of the book, a move which may be argued to be only apparently complementary. Meanwhile, amongst historians themselves, there has been considerable recent debate about the relationship between social and cultural history, both of which bid fair to be the animating force of the scientific historicism with which literary critics tangle. By making visible some of the 'pencil workings' in historiography itself, I hope to encourage literature critics to stand their ground: not to get swept away on the tide of historicism. Finally, I offer a concept of the constrained reader as a way to steer between literature and history.

Peter MIDDLETON | University of Southampton, United Kingdom

Darkening matters: historicising science and literature since 1950

This talk on historicising science and literature since 1950 grows out of research for a book on American poetry and science in the Cold War. The project began with the conviction that epistemic values played a much larger part in the poetry of the avant-garde than has been recognised by literary studies, and speculation that these epistemic values have been developed in relation to the ever growing authority of the sciences. I conjectured that some changes in poetic styles were due to the shift from one publicly dominant model of science to another, as high-energy physics gave way in public esteem to molecular biology, a shift from energy to information. What I have found is that there have been major shifts in the organisation, methods, and values of the sciences. Science communication has become highly formalised, creating new challenges for the public understanding of science. Theories and philosophies of science have proliferated and influenced many fields of inquiry, including literary theory, making self-reflexive awareness of the indebtedness to these theories essential for any theorising of this cultural history. As for values, Steven Shapin has demonstrated that old beliefs about the moral superiority of scientists have given way to the assumption that scientists and their research are at best morally neutral. One overriding feature of this period of the history of science and literature is competition for epistemological

authority, often a conflict over the rights to employ dominant epistemic (and often reductionist) metaphors such as particles, fields, codes, and genes. This competition is not only driven by the search for funding; competition is also the result of an altogether darker unease about the viability of any grand theory, whether of matter or the organism.

John HOLMES | University of Reading, United Kingdom

Historicising science and culture in Victorian England: the Pre-Raphaelites and science

In this talk I will examine some of the problems that can arise within historicist research in literature and science by looking at one particularly revealing case study: the relationship between the Pre-Raphaelites and science in mid-Victorian England. At the same time, I will argue that historicist research into the relationship of science to the wider culture, and particularly its expression in complex and suggestive art-forms such as poetry, painting, sculpture and architecture, can greatly enrich our understanding of the history of science itself. Pre-Raphaelite art may seem as far removed from Victorian science as any cultural product of its age could be, yet in their earliest writings, particularly in their manifesto periodical, *The Germ* (1850), the Pre-Raphaelites routinely invoked science as the model for their art. Even so, they left very little record of specific responses to individual scientific ideas, discoveries or texts. We do not even have very good grounds for surmising that the Pre-Raphaelites were well read in science at all. Instead, what we have is the general impression that they have of science which, while it can be correlated with certain ideas current at the time, cannot be traced to specific sources. We do know of biographical links between individual scientists and artists. Holman Hunt and John Everett Millais were friends of Richard Owen; Thomas Woolner was on very good terms with Joseph Hooker; the whole group knew Henry Acland. But again it can be hard to establish how far these friendships directly influenced their own scientific ideologies. One problem, then, is to establish what the Pre-Raphaelites meant by 'science', and why it was so fundamental to their rhetoric. Turning to Pre-Raphaelite painting, sculpture and poetry, the problem becomes still more acute, in that the Pre-Raphaelites very rarely took scientific ideas as their theme directly, or even used imagery drawn from science. Instead, their paintings and poetry were conceived of as scientific studies and experiments in their own right. So once again we are returned to the question of what that meant for the artists themselves. How can a painting or a poem be 'scientific'? What methods, approaches and techniques does this entail? Answering these questions involves moving beyond the usual range and methods of the history of science, both in the sources used and because the Pre-Raphaelites' conception of science was indefinite and did not derive directly from particular scientific philosophies, for all that in individual cases it bears the stamp of Baconism, or Natural Theology, or some other clearly defined position. But if we can answer them then we will also be able to see how science bore on the most influential Victorian aesthetic movement, and gain a much deeper sense of how the different strands of mid-Victorian culture – science, art, literature, and religion too – were interwoven.

Commentary: [Michael WHITWORTH](#) | University of Oxford, United Kingdom

S040. Science in agriculture: interactions of science, agriculture and environment

Tue 23 July, 14:00–17:30 • Uni Place 4.204

Symposium organisers:

[Ruth BARTON](#) | University of Auckland, New Zealand

[Prakash KUMAR](#) | Colorado State University, United States

Symposium abstract

This symposium explores the reciprocal interactions between agriculture, science (or technoscience) and the environment. We examine how twentieth-century technosciences have been used and shaped to solve problems in agriculture and how the solutions have, in some cases, generated new problems. In one session four presenters illustrate the diverse considerations, involving the complexities of natural systems, the needs of end-users, and institutional politics, required to solve agricultural problems. In our other session we examine political issues around the assemblage of hybrid seeds, fertilizers and pesticides that became the defining aspects of the Green Revolution. This assemblage was being recommended as a solution to the food problems of the global south even as problems with the technologies were becoming apparent in the global north. The two sessions together discuss such agricultural initiatives as historical efforts directed at "improvement", while also discussing contemporary scientific and social critiques which highlight an alternative consciousness of progress in agriculture.

In keeping with the global nature of these changes, the symposium highlights connections between developments in far-flung locations. Two presentations in the first session highlight the importance of Rachel Carson in Europe. One uses a local pollution incident in Kent to assess the impact of Carson's philosophy among early eco-activists; another examines the ways in which Carson, followed by Ralph Nader and Friends of the Earth, broadened anti-pesticides concerns in France. A third panellist teases out connections between the sensibilities of Kansans in the US and policy outcomes that shaped the Green Revolution in post-Nehru India.

The case studies of the second session address two critical components of twentieth century agricultural science – the interactions of genetics and plant breeding, and of biochemistry and the study of animal disease. Three papers focus specifically on breeding and genetics. One examines the achievements of Cambridge geneticists and their interactions with British farmers, another examines the scientific and institutional success of *selektsiya*, the specifically Russian variant of breeding practice, and another examines the scientific success but popular failure of the rice breeding experiments of the nationalist Guomindang regime in China. All three unpack the overlap of institutional dynamics with politics and breeders' communities to explore the specifics of plant breeding at the ground level. A fourth presenter studies the interactions between theory and practice to the fullest extent by analysing the tasks of specialists assigned to solve the problem of bloat among dairy cows in mid-twentieth century New Zealand. All four presentations are engaged in studying the intersection between theoretical knowledge and practical applications in the field.

S040-A. Remembering Rachel Carson: the Green Revolution and the politics of industrial agriculture

Tue 23 July, 14:00–15:30 • Uni Place 4.204

Chair: Ruth BARTON | University of Auckland, New Zealand

John F M CLARK | University of St Andrews, United Kingdom

Smarden's *Silent Spring*, 1963: pesticides, pollution, and the growth of British environmentalism

In April, 1964, veterinary surgeon F.D.T. Good offered his first-hand account of the 'Smarden Affair'. Good recounted how, throughout 1963, he had struggled to explain the sudden deaths of dogs and various farm animals near the village of Smarden in the Weald of Kent. This paper will examine a local pollution incident in the 1960s, which assumed national and international significance. It will assess the importance of Rachel Carson and of opposition to insecticides for the nascent eco-

activist movement in Britain. In particular, it will assess the traditional argument that Carson had less impact in Britain because of pre-existent governmental measures. Through an examination of unpublished governmental papers, district council papers, local and national newspapers, and specialist journals, this paper will chart the causes and consequences of the Smarden poisoning incident in Kent in 1963. In addition to the governmental and expert scientific responses, I shall investigate the social, cultural, and political implications and impact of this toxic waste incident, which seemed to confirm Carson's dire warnings about the dangers of pesticides; and the possible pitfalls of the Green Revolution. As the Smarden Affair progressed, veterinary surgeon Good questioned whether science was working effectively for agriculture. This paper will place the Smarden incident within the broader historical framework of the British reception of *Silent Spring*, the emergence of modern environmentalism, and the governmental response to insecticides, pollution, and hazardous waste. As its fiftieth anniversary approaches, the 'Smarden Affair' warrants further historical investigation.

Nathalie JAS | French National Institute for Agricultural Research, France

Pesti-, insecti-, homi- cides? Controversies on the health effects of agricultural pesticides in France during the *trente glorieuses*

In 1963, the translation of the American best-seller *Silent Spring* was a big hit in France. It launched a highly visible controversy on the detrimental health effects of agricultural pesticides, which eventually compelled the French government to revise the French system of "pesticides homologation" – established in 1943. The 1972 changes required government authorization prior to marketing any pesticides and prohibited the sale of any products that had not been granted such authorization. This paper will explore this transformation, showing how it sedimented a series of separate controversies which were deployed in different public arena with various temporalities, complexifying what was at stake within debates over agricultural pesticides and their health effects.

Controversies on the effects of agricultural pesticides started in France in the early 1950s. They were limited to specific scientific, medical, agricultural and industrial spheres. They involved scientists and medical doctors working in ecology, toxicology and occupational health research, top civil servants from the Ministry of Agriculture crop protection service, and representatives from industry and agriculture. Following the translation of *Silent Spring*, concern about pesticides' health effects were discussed very broadly in newspapers, magazines, TV programs, and put forward by the nascent French consumer movement. Linked to issues such as hormones and antibiotics in meat production, food additives and contaminants (such as plastic food containers), they then nourished a growing public concern on the health hazards posed by industrial agriculture. By the 1970s new actors took part in the controversy, bringing in new issues and debates. Organic agriculture proponents placed the debates on pesticides' health effects within the larger question of which model of agriculture to promote. Activist movements coming from abroad, such as Ralph Nader and Friends of the Earth, located pesticides' health hazards within a broader activism for environmental and consumer protection.

While analyzing these different—but interconnected—controversies, I will highlight the very limited effects of the deployment of a multifaceted critique of pesticides in France between the 1950s and the mid-1970s. I will stress how the different actors in charge of the so-called modernization of the French agriculture managed to control the potential detrimental effects of the "pesticides controversy" on their own endeavor.

Prakash KUMAR | Colorado State University, United States

A global history of the Green Revolution in India: the Kansas connection

Is it possible to connect the history of Kansas with the history of the Green Revolution in India? The Kansas Congressman Robert J. Dole visited India at the end of 1966 as part of a congressional delegation to assess the severity of famine and the steps undertaken by the Indian government to introduce high yielding variety seeds. President Lyndon Johnson's policies to induce India toward "self-help" by improving its agriculture and his use of food aid as a bargaining counter to pressurize famine-stricken India to adopt "Green Revolution" tools of hybrid seeds, fertilizers, and pesticides are known. This paper uses documents surrounding Congressman Bob Dole's visit to find deeper connections between Kansas and India at the level of social history. The papers of Congressman Bob Dole seem to provide the means to link up the sensibilities of native Kansans with policy outcomes in India. These records carry multiple historical currents seeking realization, and an aspiration to connect with the far off history of India. As they rose from the bottom of the society, from the level of day-to-day experiences of average Kansans, some of these concerns earned policy outcomes. Other sensitivities receded in the face of modernist frames and were screened out before reaching the thresholds of historical expression. But nonetheless, in their own "present," these local Kansans and their viewpoints were important in their own right. This paper analyzes those deeper, countervailing trends to provide a rich history of the influence of a prominent agricultural mid-western state in the United States on the unfolding of agricultural policy and technology in the unobvious terrain of a seemingly remote India.

Commentary: Frank UEKOETTER | Ludwig-Maximilians-University, Munich, Germany

S040-B. Agricultural science: interactions between agricultural problems and theoretical knowledge

Tue 23 July, 16:00–17:30 ▪ Uni Place 4.204

Chair: Prakash KUMAR | Colorado State University, United States

Dominic BERRY | University of Leeds, United Kingdom

The National Institute of Agricultural Botany and British genetics, 1919-1930

During the interwar period, Cambridge became the centre of scientific cereal breeding in Britain. Largely based within university departments, much of this work has appeared remote or even hostile to the agricultural community at large. However, one Cambridge institution, the National Institute of Agricultural Botany (NIAB) did place the concerns of farmers and commercial breeders at the centre of its activities. Founded in 1919 by large private and public donations, NIAB came to adopt numerous responsibilities; housing the Official Seed Testing Station for England and Wales, multiplying and selling 'pedigree' seed, monitoring the activities of commercial breeders and farmers and much more besides. However, what really came to dominate the institute's agenda was the trialling of old and new varieties under field conditions. This was a highly practical problem requiring sensitivity to differential levels of husbandry, the peculiar demands of local conditions and no small amount of cooperation with farmers (small and large) in the generation and collation of data. What is more, these practical investigations had implications for the theory of genetics.

Agricultural problems have often informed the theory and practice of science. For instance, the improving of plant varieties has been attempted from within many scientific disciplines; plant pathology, agricultural chemistry, plant physiology, agronomy and so on. I have chosen to consider the perspective of the agricultural geneticist for two main reasons. Firstly, it is already abundantly clear that the agricultural context provided important institutional and intellectual terrain for the early history of genetics. There is therefore, an existing historiography in

which to situate my work. Secondly, histories of British genetics rarely extend into the interwar period, other than to discuss elements of population genetics. This paper affords an opportunity to consider the development of genetics in a period and context that has been otherwise overlooked. The primary object of the paper will be to reconstruct how Cambridge geneticists attempted to breed better varieties and subsequently, how any purported improvement was assessed by NIAB. The trials conducted by the latter exposed varieties to be far more variable than allowed by proponents of a naive Mendelism.

Olga ELINA | S.I. Vavilov Institute for the History of Science and Technology, Russian Academy of Sciences, Russia

'Seleksiya' as a plant-breeding discipline in Russia, 1900s-1940: from breeding experiments to seed bank

This paper examines the development of the plant breeding in Russia from the early 20th century to 1940 by which time Soviet plant breeding and agricultural genetics, headed by Nikolay Vavilov (1887–1943), were among the world leaders. In this paper I trace the origins of this development. The focus of my paper is on Dionisy Rudzinsky (1866–1964), Vavilov's professor during his study in the Moscow Agricultural Institute. Rudzinsky was pioneer in the introduction of genetic theories into teaching and training of agriculturalists.

As early as 1902 Rudzinsky proposed a well-designed program to set up plant breeding stations in every region of Russian Empire. He also established the first state plant breeding station in Moscow in 1903–1908. His idea was to collect there the samples of cultivated plants for breeding research; it resulted in a number of expeditions – both domestic and foreign. Experiments inspired by Rudzinsky at the station showed an innovative approach to the theory and practice of breeding. Selection for disease resistance (1911), work delegated to Nikolay Vavilov, gave birth to the theory of immunity of plants. Another graduate student, Sergey Zhegalov, began genetic experiments (1912) into the hereditary characters of oats. Later in the 1920s Georgy Karpechenko started hybridization experiments of two genera to produce a new hybrid plant, *Raphanobrassica*.

Even more important were Rudzinsky's efforts to consolidate the new breeding community. The new discipline acquired specific national forms, as reflected in the newly invented name, *seleksiya* (from Latin *selectio*). This name proposed by Rudzinsky is still the only one in Russia to describe the discipline of plant breeding.

The efforts of Rudzinsky and the few other enthusiasts for *seleksiya* were rapidly fruitful. By the 1940s almost 140 agricultural experiment stations all over the USSR were dealing with plant breeding; the discipline was introduced into the curricula of all agricultural institutes. Nikolay Vavilov and his Institute of Plant Industry (VIR) in Leningrad conducted over 180 expeditions (1920s – 1940) to collect seeds of wild and cultivated plants. VIR's seed bank, with more than 250,000 samples, was regarded as priceless scientific resource. This success was undisputedly rooted in *seleksiya*'s theoretical knowledge and its ideology of practical implementation inherited from Rudzinsky.

Samantha CAMPBELL | University of Auckland, New Zealand

Bloat in New Zealand's dairy cows: agricultural problems and biochemical knowledge

This paper illustrates how a practical problem can shape the production of theoretical knowledge through a case study of bloat in the New Zealand dairy industry. Bloat became troublesome in New Zealand from the late 1930s as a consequence of pasture improvements designed to increase agricultural productivity. Clover and other legume species with high nutritional content, which became widespread within NZ pastures, produced higher animal growth rates and increased butterfat levels in milk, but also had serious adverse effects. The rich food produced so much foam and gas within the rumen that the cow's belly swelled

causing, among other problems, fatal pressure on lungs and heart. Bloat afflicted the herds of so many New Zealand farmers and had such major economic consequences that the dairy farming community asked that government scientists investigate and find a remedy for the malady.

Solving the problem of bloat required sophisticated multi-disciplinary approaches. It required studies of ruminant metabolism, the chemistry and nutrition of grasses and clover (including seasonal changes), and the bacteria in the ruminant stomach. Theory was not simply available to be 'applied' but new areas of study, such as ruminant metabolism, had to be developed. Moreover, any proposed solution had to be economically viable and feasible in the paddocks of a normal working dairy farm under New Zealand pastoral conditions. The research programme that resulted combined field and lab scientists from different disciplines (biochemistry, microbiology, chemistry, physiology) who worked together to produce new knowledge. Researchers developed innovative methods to investigate the metabolic processes *in vivo*. In so far as separation is possible, the paper will focus on biochemistry in illustrating the ways in which new knowledge and approaches came from researching the agricultural problem.

Seung-joon LEE | National University of Singapore, Singapore

Scientific rice breeding and its discontents: the crop improvement program in Republican China, 1927–1949

It is well known that when the Guomindang (KMT) lost the minds and spirits of peasants it paved the way for the Chinese Communist Party's eventual victory in 1949 after the decades-long political rivalry. However, this is not to say that the Guomindang disregarded the agrarian question or only protected the landlords' interests. Rather, the Guomindang Nationalists expended greater energy toward improving the rural problem than the communists could have done. The major distinction was that the Guomindang placed their emphasis less on the class relationships between the "haves" and the "have-nots" and more on the question of overall agricultural productivity.

The rice breeding programs led by the Central Agricultural Experimental Institute (CAEI), founded in the inaugural year of the Nationalist Government in Nanjing, represent the Guomindang regime's unsparing efforts to resolve the agricultural problem and reduce rural poverty in China. The CAEI spearheaded rice-breeding experiments, with the full support of the regime, and produced great numbers of new high-yield rice varieties in the following decades. However, this scientific achievement could not assure the market success of new rice varieties, because the marketability of rice was determined not by the improvement in productivity but by the rice-consuming public and its discriminating dietary preferences. Thus, in evaluating the success of the programme local and practical contexts must be taken into consideration. How did the CAEI's agricultural scientists, mostly trained in agricultural programs in the United States and Japan, understand the rice quality question? How did the rice-eating public respond to the rice improving program drafted and put into practice by the Republic's "best and brightest" agricultural scientists? By focusing the issue of marketability of rice, this paper illuminates the incommensurability between agricultural science in the elite institution and the rice-eating public in the marketplace.

Commentary: **Francesca BRAY** | University of Edinburgh, United Kingdom

S042. Practising photography in the sciences

Thu 25 July, 09:10–12:40 • Uni Place 4.205

Symposium organisers:

Geoffrey BELKNAP | Harvard University, United States
Kelley WILDER | De Montfort University, United Kingdom

Symposium abstract

'Photography at work in the sciences' trains the debates about visualization on the very compelling medium of photography. The symposia pulls together scholarship from Science and Technology Studies, Anthropology, Art history, Photography and History of Science to analyze what happens to science when scientists produce, consume and disseminate photographic materials. Photography has often been presented as a benign, objective recording technique without agency that fits itself seamlessly to the purposes of sciences, and thus it has often been overlooked in more complex modeling of scientists' behavior, and in the investigation of the concepts of observation and experiment. As a subject within scientific visualization, photography has also taken a smaller role than drawing, although from 1870 to 1960 it insinuated itself slowly into every aspect of modern science, from experiments and observations that are wholly dependent on a photographic method, through to the publication and exhibition of scientific results. Far from being merely an illustrative mechanism, photography plays an active role in forming scientific research questions, in defining scientific discovery and even in the very definition of some scientific disciplines. Yet we know very little about the role of photographers, photographic materials and industries in scientific practice, and there has been only sporadic concentration on the way in which visualizing with photography differs from visualizing with other media. The key questions of this symposia will be: how were photographs used to put knowledge to work; what are photographs' boundaries?; and how do they help define discovery? We will interrogate these questions by looking at the transitional period of 1870-1960 with the aim of gaining a better understanding of the situated contexts of the use of photography in the sciences, as well as how this use changed over time. In 'Photography at work in the sciences', we will take stock of the current state of research, evaluate research methodologies developed in heretofore disparate fields, and generate research questions for this nascent, fast growing area of study.

S042-A

Thu 25 July, 09:10–10:40 • Uni Place 4.205

Chair: **Sadiya QURESHI** | University of Birmingham, United Kingdom

Geoffrey BELKNAP | Harvard University, United States

"Carte correspondence": the photographic portrait network of Charles Darwin

In January 1867, Charles Darwin's closest friend Joseph Hooker wrote to Darwin – tired of being his photographic intermediary. Requesting a Carte de Visite of Darwin for Prof. Miquel of Utrecht, Hooker laments "I grieve to bother you on such a subject— I am sick & tired of this Carte Correspondence." This paper looks to tease apart what a photographic portrait meant for Darwin, the quintessential 19th century man of letters. When we think of Darwin's correspondence, we often talk about how he created, maintained, and used written letters to reinforce his scientific credibility and to motivate his correspondence to bring the experimental field to his house at Down. While his writing was certainly essential to this aim, when examining his letters what is also evident is just how important his photographs were to maintaining his scientific network. Darwin's photographs and his carte de visites circulated around the European continent and across the Atlantic Ocean, and ended up on the walls of many well-known scientists and he equally requested and collected photographs of his scientific friends. This paper will therefore bring together concerns in the history of letter writing and in photographic history to address what it meant for a nineteenth century

scientist to exchange photographic objects, and how the collection and exchange of these objects developed into a form of scientific practice.

Efram SERA-SHRIAR | York University, Canada

Composing a photograph: Francis Galton and the 'application of composite portraiture for anthropological purposes'

In the late 1870s and early 1880s the Victorian polymath Francis Galton (1822-1911) produced a series of papers on the application of composite portraits for anthropological purposes. He argued that his technique for producing composite portraiture would enable researchers interested in human variation to visually display "true anthropological averages". Because composite images layered many anthropological subjects on top of one another, Galton believed that composite portraiture made it possible for researchers to examine more data faster and more efficiently. It was easier to calculate averages because you could cross-measure various features using a single set of composite images. Building on the recent work of historians of science including Secord (2002), Bleichmar (2007), and Daston and Lunbeck (2011), this paper will discuss the relationship between observational practices, imagery, and the natural sciences. In particular, it will examine Galton's attempt to develop a photographic project within British anthropological circles that systematically classified the various physical features in different races. Moreover, using his statistical theory, Galton aimed to show patterns of similarities and differences between the physical conformations of human varieties. This paper will examine a range of material including Galton's writings on composite portraiture, and the composite photographs he produced. Drawing together several major disciplinary shifts occurring in the later part of the nineteenth century, this paper will connect Galton's anthropometric photography to the some of the larger debates about racial variation and scientific practice during the late 1870s and early 1880s.

Omar NASIM | ETH Zurich, Switzerland

Drawing photographs: celestial objects on the plate and on paper

Despite the "revolutionary" application of astrophotography to the heavens, and to the nebulae in particular, champions of mechanical means of reproduction continued to prefer to make hand drawings directly off photographic plates. This practice continued well into the twentieth century. Considering that sometimes multiple plates would be used to compose one composited drawing, it seems that hand drawings were used for more than just their clarifying effect. This paper proposes to examine the theoretical and cultural contexts for this practice, especially between 1890-1915.

Commentary: Sadiya QURESHI | University of Birmingham, United Kingdom

S042-B

Thu 25 July, 11:10–12:40 • Uni Place 4.205

Chair: Elizabeth EDWARDS | De Montfort University, Leicester, United Kingdom

Kelley WILDER | De Montfort University, United Kingdom

Using stereo photography for scientific observation

While stereo photography is often seen as merely a popular amusement, it nonetheless constitutes a particular photographic method deployed in various sciences to observe landscape, identify particles, and reproduce optical phenomena. This paper addresses the use of stereo photography in several case studies across the natural sciences to better understand how this peculiar type of photography was put to work in doing observation of a very particular kind.

Damian HUGHES | De Montfort University, United Kingdom

Hidden in plain sight: early ecology as visual science

Scientific discourses of ecology began to cohere in the first decades of the twentieth century. The making, distribution and use of photographs amongst early ecologists indicate a fundamental role for visualization in constituting and communicating the new science. This paper will consider the role of visual practices in constituting and mediating ecology as new specialist knowledge as ecologists strove to define their object of study and to fashion a common conceptual framework for their subject.

Commentary: Elizabeth EDWARDS | De Montfort University, Leicester, United Kingdom

S043. Creating facts: disputed knowledge-claims in the nineteenth century

Thu 25 July, 09:00–12:30 • Uni Place 1.218

Symposium organisers:

Carin BERKOWITZ | Chemical Heritage Foundation, United States

Catherine JACKSON | University of Notre Dame, United States

Symposium abstract

The symposium will address the ways in which knowledge was constructed and conveyed in the 19th century by focusing on moments of dispute and contestation. It aims for broad coverage of both period and subject, exploring how the emergence of disciplines, the development of scientific periodicals, the standardizing of materials and measurements, and the increasing significance of priority altered the nature of what constituted knowledge and how that knowledge was rendered certain, trustworthy, and useful. The symposium will be broken into 2 panels that address the theme in interrelated ways, with 8 speakers and Michael Gordin as commentator.

Establishing and Standardizing Knowledge: Catherine Jackson examines the problem caused by the introduction of synthetical experiments into 19th Century chemistry. How could chemists know what they had made? Jackson explains how, by 1870, they resolved this chemical identity crisis. Michael Finn's paper looks at the development of cerebral localisation in the late 19th century, when an emerging neurological profession in Britain adopted various methods of investigation to study the functions and diseases of the brain. Will Ashworth goes beyond the academy, addressing the role of the excise in standardizing measurement. Taxing the manufacture and movement of goods was a powerful driver of developments in instrumentation. Finally, Michael Kershaw's paper addresses how the value for Paris-Greenwich longitude – an important astronomical and geodetic standard – was determined with the use of the new electric telegraph. Conflict between determinations was integral to the process of improvement, whilst the eventual establishment of a trusted value involved factors wider than simple numerical consistency.

Communicating Knowledge: Carin Berkowitz will discuss the priority dispute Charles Bell and Francois Magendie over the roots of motor and sensory nerves, focusing on shifting definitions of "the discovery" and international debates about credit. Alex Csiszar will address the role of journals in establishing priority. Print publication had always been an important factor in priority of discovery, but it was only during the mid-19th century that the specialized journal became its principal bearer.

Building on the theme, Pedro Ruiz-Castell will examine how speculative articles published in daily newspapers and addressed to a general public became an important tool for some scientists to later use to claim priority in controversial topics in front of the international scientific community. Finally, Gregory Radick's talk integrates various kinds of scientific claims for credit, attending to interactions among 3 different sorts of knowledge-claims and their disputes: claims to have discovered something first (priority claims); claims to have invented a useful technology first (patent claims); and claims about the power of scientific knowledge to explain and generate useful techniques and technologies (productivity claims).

S043-A. Establishing and standardizing knowledge

Thu 25 July, 09:00–10:30 • Uni Place 1.218

Chair: Michael GORDIN | Princeton University, United States

Catherine JACKSON | University of Notre Dame, United States

Chemical identity crisis

Histories of nineteenth-century chemistry have focused on what organic chemists made using which reactions. But an equally important issue for the chemists themselves was how to identify what they had made. By its smell? By its taste? By its chemical reactions? By its physical properties? By its ability to kill frogs? And whilst chemists in different labs knew a dead frog when they saw one, they certainly didn't always agree about melting and boiling points. At the mid-century, for example, boiling points reported for coniine, the active constituent of hemlock, ranged over more than sixty degrees – which surprised nobody. And as we follow this history things get even worse: the product of the first claimed synthesis of coniine turned out not to be coniine at all, even though it killed frogs in exactly the right way!

So how did nineteenth-century organic chemists identify the products of their reactions? When and how did melting and boiling points become decisive arbitrators of chemical identity? And what does all this tell us about chemistry in the nineteenth-century that we didn't already know? A fresh history of synthetic organic chemistry?

Michael FINN | Leeds University, United Kingdom

Mapping out the Victorian brain

The final decades of the nineteenth century were an era of scientific and medical specialisation, when the 'common context' of Victorian culture began to break down and separate disciplines took on their own form, conducted in different settings, by different people, and published in different places.

In particular, this period saw the emergence of a mature neurological profession, as neurology became a specialty of its own, distinct from general medicine on the one hand, and psychology (whether medical, experimental or philosophical) on the other. A new programme of brain research, based around the study of cerebral localisation, appeared to achieve rapid and spectacular results and a large legion of followers. In doing so, neurology cleaved away from psychiatric practice in Britain, and the search for localised functions and organic lesions in the brain – so long a guiding motif of psychiatry – came instead to be associated with the neurological profession, leaving psychiatry to deal with the chronic, awkward and less clear-cut illnesses that affected the brain. In this paper, I will consider the theory of cerebral localisation in this period, looking at the way that clinical, pathological, anatomical, microscopical and experimental evidence was used to construct an understanding, and an image, of the brain. In particular, I will use the development of cerebral localisation as a way to chart the increasing separation between psychiatric and neurological perspectives of the brain, and to explain the different trajectories of the two disciplines going into the twentieth century. With twenty-first century medical specialists now often

bemoaning the separation between psychiatry and neurology, and looking to reintegrate the two fields, it is informative to look back to the nineteenth century to understand how, and why, they became separated in the first place.

William J. ASHWORTH | University of Liverpool, United Kingdom

The British excise, instrumentation and manufactures in early nineteenth-century Britain

The 1780s was a critical decade for British economic policy. It was a time of forced reform driven by fiscal urgency and fear in the wake of losing the mainland American colonies. An event, after all, partly aided by the excruciating weight of the increasingly unsustainable national debt that had accumulated greatly since the end of the Seven Years War (1756-1763). William Pitt the younger desperately needed more revenues and had no choice but to raise existing taxes. This meant much greater pressure on the excise to extract levies from increasingly aggrieved manufacturers. This, in turn, led to greater protests and attempts by taxed industry to challenge excise gauging methods. In particular, endeavours by manufactures to evade tax via the use of illicit ingredients and, indeed, challenge the Excise's process of measurement led to ever more intricate ways of detecting the composition of taxed items. By the 1810s this included the sophisticated use of illicit materials in underground complexes, and the hiring of men of science to contest excise techniques. This fuelled ever greater technical attempts to analyse food and drink culminating in the establishment of the Laboratory of the Government Chemist in 1842 to police excised manufactures. In this way raising revenue by taxing the manufacture and movement of goods, was a powerful driver of developments in instrumentation and production of certain goods in nineteenth century industrial Britain.

Michael KERSHAW | Imperial College London, Switzerland

'A thorn in the side of European geodesy': measuring Paris-Greenwich longitude by electric telegraph

The difference in longitude between the observatories of Paris and Greenwich was an important standard – long of relevance to astronomy, geodesy, navigation and timekeeping. Measured many times and by many different means since the 17th century, the preferred method of the later 19th and early 20th centuries used the electric telegraph to compare traditional astronomical time determinations at the two observatories. I describe here for the first time, from both published and archival sources, the four Paris-Greenwich telegraphic longitude determinations made between 1854 and 1902.

The first gave a result materially different from the value that had been trusted for decades, yet was adopted in large part because of assertions of the excellence of the new telegraphic technique. It was soon found to be inaccurate. A second determination showed a modest but irreconcilable difference between the French and British results. There followed an ill-tempered dispute over which was to be relied upon, and the exercise ended in failure. A third failed in exactly the same way. So by the 1890s the uncertainty over Paris-Greenwich longitude was described as a 'thorn in the side of European geodesy', and there was international pressure for a definitive and fourth determination. This final telegraphic measurement was said to have completely settled the matter of the correct value; there was, however, far from clear-cut evidence for the claimed success.

I use this as a case study in precision measurement, showing how comparison and dispute between different measurements, in the search for 'reasonable agreement' between them, was an important force for change and improvement. What constituted reasonable agreement is shown to be only tenuously related to numerical consistency; rather, it was highly contingent on the contemporary interpretation of inconsistencies and on external circumstances. I also show that the

resulting improvements in precision had more to do with the gradually improving methods of astronomical time determination than with the singular innovation of the telegraph, thus emphasising the importance of what have been described as 'observatory techniques' to 19th century practices of precision measurement.

Commentary: Michael GORDIN | Princeton University, United States

S043-B. Communicating and disputing knowledge-claims

Thu 25 July, 11:00–12:30 • Uni Place 1.218

Chair: Michael GORDIN | Princeton University, United States

Carin BERKOWITZ | Chemical Heritage Foundation, United States

Pedagogy, publication, and priority: the changing landscape of a disputed anatomical discovery, 1800-1840

In the early 19th Century, Charles Bell and François Magendie engaged in a priority dispute over the discovery of the roots of motor and sensory nerves. The dispute, which lasted for most of Bell's professional life, illuminated the ways in which medical science was changing. When Bell first wrote on the nerves in 1811, surgeon-anatomists ran small schools of anatomy in their homes, natural Theology was in vogue, exchanges between British and French medical practitioners were limited by the Napoleonic Wars, and British practitioners seemed to be rejecting the vivisection that was being adopted in France as a method for understanding the body. As was typical at the time, Bell developed both a specialist and non-specialist audience for "his discovery," which he presented to the scientific community through lectures at his Windmill Street School of Anatomy, thereby drawing a larger number of students who would help generate income. By the end of Magendie's career, medical science had changed. It was produced in the laboratory, a closed space belonging to expert scientists. It was taught through artfully produced and mastered performances, of the sort at which Magendie excelled, in classrooms and lecture theaters, the semi-restricted spaces of science. And finally, medical science was disseminated through journals, a space proclaimed to be open and unrestricted for purposes of priority disputes. As this priority dispute reveals, the rise of scientific experts and creation of disciplines and specialties, long recognized as hallmarks of modern science, occurred alongside, and sometimes by means of, a division of the spaces for science that had previously been united by their pedagogical purposes. Over the course of Bell's career in London, and of his priority dispute, pedagogy lost pride of place, and the priority dispute was settled for history as much by those changing spaces of science as it was by work on the "discovery" itself.

Alex CSISZAR | Harvard University, United States

Priority of publication and patent reform in Britain and France, 1824-1848

During and after the Napoleonic wars, European savants struggled to revamp their institutions and forms of life in the context of rapidly evolving political cultures and legal frameworks. The procedures, functions, and genres associated with scientific publishing constituted a particularly central site for these attempts at reinvention. In Britain and France, the scientific journal – a more or less new kind of publication with roots in the late eighteenth century – took on central roles in registering knowledge claims, adjudicating priority, and making up savants' identities. This paper will focus on controversies over the role of print in priority disputes during 1840s. First, the problem of how best to mark discovery claims arose in France in a controversy between François Arago and Guglielmo Libri; this began as a disagreement over how to write the history of science, but expanded into a broad

controversy over the status of the meetings of the Académie des Sciences after its public character had become associated with an official journal (the *Comptes rendus hebdomadaires*). These norms and procedures then became a matter of dispute between French and British savants over the discovery of the planet Neptune in 1846. At stake was the nature and bounds of the appropriate public for discovery claims, the relationship between discovery and other debates about intellectual property, and the politics of national and international cooperation in the sciences. This talk will focus in particular on the distinct ways in which debates regarding patent law reform in Britain and France inflected the changing meaning and mechanics of scientific priority.

Pedro RUIZ-CASTELL | Institut d'Història de la Medicina i de la Ciència López Piñero, Spain

Priority claims and the role of general-interest newspapers in the age of specialized scientific journals

The nineteenth century has been pictured as a period of institutionalization and professionalization of science. The establishment of new specialized scientific journals during the second half of the nineteenth and early twentieth centuries has traditionally been seen as part of this process, which had to lead to the establishment of scientific disciplines. In this context, the new specialized journals not only published research results relevant to specific branches of scientific knowledge, but also became spaces where priority claims were disputed and validated by an international community of experts.

Nevertheless, the non-specialized press kept playing an important role during those years in providing social and scientific prestige, legitimacy, and power to scientists. In particular, the role played by daily newspapers was crucial during the late nineteenth and early twentieth centuries in disciplines with a strong presence of amateur scientists, such as astronomy. In fact, several scientists presented in these general-interest publications some of their most controversial hypothesis and scientific ideas. No doubt, some scholars found it easier to present to a lay audience their intuitions, thoughts and theories on disputed natural phenomena. This was encouraged by the fact that these texts, addressed to a lay audience, could be far more speculative than the papers to be published in specialized journals – to be read by a more demanding international scientific community.

As this paper will demonstrate, these articles published in general-interest publications became even more useful in peripheral countries. Here, scientists had more difficulties engaging in scientific disputes and priority claims with the international scientific community. The non-specialized press proved crucial to gain social legitimacy and authority in the public sphere, which opened the doors for developing an academic and/or professional career in science. Therefore, as this paper will show, speculative articles published in daily newspapers and addressed to a general public became an important tool for some scientists to later use them as authoritative texts and claim priority on controversial topics in front of the international scientific community.

Gregory RADICK | University of Leeds, United Kingdom

Priority claims, patent claims, and productivity claims: the case for an integrative approach

The sociologist of science Robert Merton long ago proposed that, for purposes of understanding the rise of modern science, there was much to be gained by considering priority disputes and patent disputes as linked under the concept of "intellectual property". This paper will briefly sketch the case for an updated and expanded version of this proposal, with particular attention to how three different sort of knowledge-claims, and disputes over them, have interacted over the historical long-run: (1) claims to have discovered a principle or phenomenon before anybody else did (priority claims); (2) claims to have invented a useful technique or technology before anybody else did (patent claims); (3) claims about

the power of a body of scientific knowledge to generate useful techniques and technologies thanks to its latching onto reality (productivity claims).

Commentary: **Michael GORDIN** | Princeton University, United States

S044. Forensic histories: global perspectives

Fri 26 July, 09:00–12:30 • Uni Place 4.213

Symposium organisers:

Peter BECKER | Institut für Geschichte, Universität Wien, Austria

Ian BURNEY | University of Manchester, United Kingdom

Symposium abstract

In recent years, forensic medicine and science have attained unprecedented visibility, representing a uniquely compelling and at times contentious, example of applied expertise. Dominated by new laboratory-based techniques, modern practitioners and the public they serve live in an apparent era of forensic infallibility, characterised by precision methodologies deemed capable not merely of solving the most intractable of contemporary criminal cases, but also of retrospectively assessing, and often correcting, conclusions derived from past investigations. The declarative powers of modern forensics has penetrated the public imagination, showcased on in daily newspapers, in best-selling novels and on highly rated television shows.

This two session symposium seeks to place these developments in historical and trans-national perspective. Session one, “Spaces and Traces”, focuses on techniques and practices of forensic investigation in the late nineteenth and early twentieth centuries, with special emphasis on approaches to the identification and interpretation of crime scene traces in China, India and Britain. Session two, “Questions of Expertise”, considers the construction of knowledge in over the course of the twentieth century European court cases arising from a variety of (often contested) disciplinary positions: from dactyloscopists, psychiatrists, criminologists, psychoanalysts and sexologists of the first half of the century, and their neuroscientific and geneticist successors.

S044-A. Spaces and traces: global takes on forensic investigation in the late nineteenth and early twentieth centuries

Fri 26 July, 09:00–10:30 • Uni Place 4.213

Chair: **Christopher HAMLIN** | University of Notre Dame, United States

Neil PEMBERTON | University of Manchester, United Kingdom

The detective as hunter: gentlemen, English bloodhounds and canine forensics, 1880-1920

This paper examines the emergence of the modern practice of canine forensics during the years between 1880 and 1920, focusing primarily on British and American contexts. In the dawning age of forensic modernity, emboldened by the belief that traces left at a crime scene could betray the perpetrator and only the trained mind could find such physical clues, the pure-bred English bloodhound appeared to be uniquely focused, and singularly equipped for the tracking of criminal miscreants having fled a crime scene. Breeders, detectives, journalists, lawyers, mobs, victims of

crime, and crime writers, came to believe that no other dog hunted traces of human scent like a pure-bred bloodhound.

Core to this method of detection was the unique, distinct relationship between dog and handler. The two shared a bond, apparent in how they worked collaboratively towards the same objectives: the identification of hidden clues at the crime scene, tracking of a human scent trail and, ideally, eventual capture of the criminal. As scent was (and is) largely invisible to human senses, handlers came to develop an observational virtuosity, as at least to an extent, the success of bloodhound pursuit depended upon their ability to interpret their dogs' reactions to the scent.

In this paper I will discuss the forensic, legal and public perceptions and assessments of this venatic form of deduction, which, in the words of the cultural historian Carlo Ginzberg, 'binds the human animal closely to other species.' Special attention will be given to how this mode of detection involved a powerful and seductive form of conjectural knowledge, derived from a distinct partnership between animals and humans. Attending to its resonance within contemporary forensic knowledge and practices, as well as wider ideas about the roles and abilities of some dog breeds in Anglo-American culture, I will try to provide a detailed context for understanding the allure of bloodhound pursuit at the turn of the twentieth century. However, for some the canine nose was far from a reliable tool of detection. Forensic traces that could only be accessed through hunting lore and canine instinct were unavoidably imbued with interpretative problems and ambiguities. To some the abilities of dogs to perceive things which the human senses could not bore a supernatural aura in the wider public imagination and gave the mode of forensics the appearance of infallibility.

Projit MUKHARJI | University of Pennsylvania, United States

Machinic forensics: battling techno-criminality in colonial Bengal, c. 1890-1940

By the end of the nineteenth century everyday machines ranging from bicycles and typewriters to watches and sewing machines were increasingly becoming part of Indian lives. As the heartland of British power in the region, the Bengal Presidency was particularly well-served by the percolation of everyday machines. Naturally, some of these machines soon became part of the hardware of criminal operations. Anonymous ransom notes were written on typewriters, robbers fled on bicycles and sewing needles were used as murder weapons. This is what I call technocriminality, viz. criminality that was crucially constituted by the deployment of technological objects and knowledge. By necessity, those tasked with fighting such technocriminality had to evolve new modes of detection. Ways had to be found for distinguishing one typewriter from another, to recognize one bicycle track from another etc. As a result there evolved what I dub machinic forensics.

Technocriminality and machinic forensics were mutually co-constituted through their opposition. Every time the one advanced the other had to catch up. If the detectives were ahead, the criminals found new ways to cover their tracks and if the criminals were on top the detectives had to upgrade their methods. By looking at criminality and forensics as mutually constitutive and by fore-staging technological objects in their relationship, I believe we can unravel a hitherto neglected dimension of forensics: away from its usual focus on the internal dynamics of the development of individual techniques. By drawing upon police records, memoirs of police officers, news-reports and crime fiction, I shall demonstrate how everyday technological objects became the crucial link connecting technocriminality and machinic forensics in a process of escalating mutual evolution.

Ian BURNEY | University of Manchester, United Kingdom

Crime labs and crime scenes: the landscape of forensic investigation in interwar Britain

This paper considers the development and interaction between two new sites of scientific practice in the interwar period – the crime scene as a space of disciplined investigation, and the crime laboratory as the site for the deployment of new techniques and technologies of investigation. To

be of use to the crime lab, crime scene officers needed to be instructed both about the new analytical horizon opened up by these institutions, but about how they needed to conduct themselves in and treat the crime scene and the traces they harvested from it in a manner that was compatible with the needs of the labs.

S044-B. Questions of expertise: experts in criminal investigations and criminal trials

Fri 26 July, 11:00–12:30 ▪ Uni Place 4.213

Chair: Peter BECKER | Institut für Geschichte, Universität Wien, Austria

Emilia MUSUMECI | University of Catania, Italy

The role of forensic expertise in Italian courts: from alienists to neuroscientists

The purpose of this paper is to explore the role of mental health experts in Italian Judicial System through a historical approach. First of all, it will be analysed the current use of brain science in assessing criminal responsibility, by retracing the so-called neuroscientific paradigm, which considers thoughts as a result of synaptic connections, mere brain images to be captured by fMRI, and that is now permeating all areas of knowledge. It is therefore not surprising that these techniques, far from remaining closed in aseptic laboratories, have now entered even the austere courtrooms. So, faced with the disintegration of the power of psychiatrists and their expertise, now deemed less objective and less certain, in the courts the judges are increasingly choosing to rely on techniques that appear more "certain" and "infallible" than others. If once new technologies were mostly used during the investigating period preceding the trial, now the possibility of "reading the brain" of the accused, seems to be a new and unsettling reality of modern trials. Secondly, it will be examined whether the entrance of neuroscientists in courtrooms represents a novelty, in order to understand continuities and discontinuities between old and new kind of expertise. Indeed, judges every day have to decide on the mental capacity of the accused, for the purpose of to distinguish who must be punished from who must be cured. In spite of the Latin maxim 'iudex peritus peritorum', they have been appointed experts witnesses to make this problematic decision, since the nineteenth century, when the "alienists" like Cesare Lombroso had entered in courtrooms. After that, new experts such as psychiatrists, criminologists, psychotherapists, psychoanalysts (and today neuroscientists and geneticists) cooperated with judges holding an unchanged role: that of 'truth-seekers' or last delegates of the oracle.

Daniel MEBNER | University of Vienna, Austria

Fingerprinting and crime scene investigation: how biometrics changed the search for evidence

The introduction of fingerprinting around 1900 changed crime scene investigations radically. Police experts within the records departments experimented with techniques and chemicals to find a way of making fingerprints visible and fileable. This strengthened the role of material evidence, and police work saw a professionalisation in two ways: On the one hand, the police records departments launched an expanding system of identification based on biometric techniques, since the most important part of the identification procedure was to classify and to archive the traces in a way to enable distinct correlations between traces and offender. On the other hand, police experts represented dactyloscopy as an identification technique in public as they prepared and presented expert testimonies in court, where they had to establish fingerprinting as evidence without doubt. Franz Eichberg, the head of the Viennese records department in the 1920s, was welcomed in court by mistrust: "Mr authorised expert today you won't be in luck with your dactyloscopy, as our jurymen are not ready yet for your dactyloscopy."

Fraser JOYCE | Oxford Brookes University, United Kingdom

Re-imagining the 'expert' before the unknown corpse

Traditionally, the 'expert' in the courtroom acts as an historical prism through which scholars can study the means by which ideas, technologies, or disciplines became established following legal battles exposed to public and professional scrutiny. But what more can be learned by considering the use of privileged or specialist knowledge *outside* of this adversarial environment?

This paper explores the concept of 'expertise' in the context of investigations into the identification of the unknown dead in nineteenth-century England and Wales. In the majority of these cases, those presenting privileged or specialist knowledge vital to the investigation (local doctors, law officers and laymen) did not resemble the familiar 'expert' of the criminal trial, nor was their evidence scrutinised in a similar fashion. This paper argues that the study of 'expertise' should not be confined to the courtroom, and that the concept of 'the expert' should be made more inclusive, in order to create a more representative portrayal of medico-legal practice.

Commentary: Peter BECKER | Institut für Geschichte, Universität Wien, Austria

S045. Mathematical facets of measurement, measuring units, measured quantities and their uses

Sponsoring bodies:

IASCUD: International Association for Science and Cultural Diversity

European Research Council Advanced Research Grant 'Mathematical sciences in the ancient world' (SAW)

Mon 22 July, 11:00–17:30 ▪ Roscoe 1.007

Symposium organisers:

Karine CHEMLA | European Research Council, CNRS & Université Paris Diderot - Paris 7, France

Agathe KELLER | Université Paris Diderot - Paris 7, France

Cécile MICHEL (non-participant) | ArScAn – HAROC, UMR 7041, CNRS, France

Robert MIDDEKE-CONLIN | Université Paris Diderot - Paris 7, France

Christine PROUST | Université Paris Diderot - Paris 7, France

ZHU Yiwen | Université Paris Diderot - Paris 7, France

Symposium abstract

Issues related to measurement are a key concern for the history, philosophy and sociology of the natural and social sciences. However, for mathematics hardly any attention has been devoted to them. Indeed, historians and philosophers of mathematics have dealt with measure when it was a central notion in a mathematical theory (for instance, in Euclid's *Elements* or Lebesgue's measure theory). Historians and sociologists of mathematics have also addressed the symbolic or political meanings of systems of measuring units, their standardization, and their enactment. However, the knowledge involved in the production of measured quantities and the mathematical operations with these quantities has hardly been treated. In fact, mathematics studies (as in

“science studies”) seem to have shared the tacit assumption that the work with measured quantities was of no interest for the field, since past practitioners immediately converted any numerical value into an “abstract number” and their mathematical operations started when they were working with such “numbers.” Measuring units appear to have been transparent for this research field. The symposium aims at exposing the shortcomings of these assumptions and at exploring the mathematical facets of measurement, measuring units, measured quantities and their uses.

What were the mathematical facets of the work engaged in the actual design of measuring units and material standards for them? How did these facets connect with other facets of the design of measuring units? Do mathematical texts reflect this work?

How were measuring standards used? This question implies taking into account several types of actors. Can issues related to measuring standards help us perceive distinct social groups? Can they cast light on the distinct social uses of measuring units and show how different social groups interacted in this respect?

How did actors measure and use measured quantities? Can we identify the knowledge involved in the activity of measuring and understand how this knowledge was acquired? We also intend to identify strategies devised by actors to deal with the values they obtained. How was the shift between measured quantities and abstract numbers conceptualized and handled in different contexts? Were instruments shaped to work and compute with measured quantities? We hope that such questions allow us to identify, through the variety of their practices, distinct social groups and the kinds of knowledge they shared.

How can we assess the part played by measurement in the context of various types of activities and how practices of measurement were organized? In this respect tax payment and the organization of labor are as important as business or domestic activities.

We expect that this set of issues can bring mathematics studies closer to an anthropological study of actors of the past in their knowledge activities.

S045-A. How did actors compute with measured numbers? Part 1

Mon 22 July, 11:00–12:30 ▪ Roscoe 1.007

Chair: Agathe KELLER | Université Paris Diderot - Paris 7, France

Christine PROUST | Université Paris Diderot - Paris 7, France

Abstract numbers and measures in old Babylonian southern Mesopotamia: norms and variations

Material from Mesopotamian scribal schools provides a full description of metrological and numerical systems used in Old-Babylonian period. These documents, when closely observed, reveal the efforts made by ancient scholars in order to shape metrological and numerical systems more and more regular, unified and coherent, and to define different sorts of numbers according to their use (quantifying or computing). They reveal also how these systems were developed in relation with specific techniques for computing surfaces and volumes. These strongly standardized systems were widely used in mathematical texts, as well as, to a large extent, in administrative and commercial texts. However, the coherent system for quantifying and computing magnitudes developed in southern scribal schools was unevenly disseminated in different milieus, or different regions. In the first part of this paper, I describe some aspects of the standardization process. In the second part, I show how mathematical practices with abstract numbers and measures in some southern Mesopotamia schools may break the framework inherited from elementary education.

Carlos GONÇALVES | Universidade de São Paulo, Brazil

Abstract and measure numbers in the Diyala region: an example of fluctuating and overlapping roles

Mathematical clay tablet Haddad 104 was published in 1984 by Michael Roaf and Farouk Al-Rawi and it has since been considered a very important piece of evidence for the study of the mathematics of the Old Babylonian period. Its provenance is the ancient city of Me-Turan, in the region of the Diyala river, and the tablet offers a mixture of general characteristics of Mesopotamian mathematics with regional traits of the Diyala region. It brings ten problems, dealing with grain containers, measuring vessels, work load and brick making, matters with a clear empirical appeal and so with high interest for the study of measure in antiquity. In this tablet, numbers accompanied of units of measure (measure numbers) and numbers without measure units (so-called abstract numbers) are intensely employed. The literature of the field of the history of cuneiform mathematics strongly supports the interpretation that measure numbers were used to provide the data in the statement of problems and often to write the final answers, whereas abstract numbers were used in intermediate numerical calculations. The passage from one type to the other was helped by specific texts which associated them, the metrological tables. Haddad 104 is on the whole consistent with this picture, but some of its passages make the distinction between these types of numbers a blurred one, especially some conversions of length measures which seem to be made within the frame of abstract numbers. Besides, other passages show that calculations could be carried out with measure numbers as well. For example, some problems speak of “the reciprocal of 1 mina of silver” or multiply “2 by 1 sila of grain” or “1 by 1 talent of silver”. Both cases point to a differentiation of the mathematical tradition that, together with the linguistic features of this tablet, help characterise the mathematics of the Diyala region, confirming Haddad 104 as a very rich source of examples of mathematical practices related to measure and units of measure. Thus, in the present paper, I offer an analysis of its text showing that the scribe who wrote it – and by extension, the milieu where it was produced – was able to deal with measure and abstract numbers in a way that their roles could fluctuate and even overlap. From the historiographical point of view, this modulates the distinction between these numbers and enriches our knowledge of the mathematical facets of measure in Ancient Mesopotamia.

ZHU Yiwen | Université Paris Diderot - Paris 7, France

The uses of quantities involving measuring units in computation in seventh-century China

This presentation will commence with an introduction of newly discovered sources and examine them in order to identify the different cultures of computation they exhibit. These documents are commentaries made by Jia Gongyan 賈公彥 (7th century) on Confucian canons. By relying on these sources, we shall see there existed at least two cultures of mathematics in 7th century China. Furthermore, in order to cast more light on these sources, I shall compare them to the mathematical books handed down through the written tradition. Li Chunfeng 李淳風 (602-670 C.E.), the main editor of a 7th century edition of Ten Canons of Mathematics, was a contemporary of Jia Gongyan's who also wrote commentaries on mathematical canons. By comparing the two sources, we shall see that they bear witness to different uses of measuring units in computation. Finally, I shall account for the differences between the two types of cultures of computation in social terms, by discussing Jia Gongyan's and Li Chunfeng's biographies. In my view, the key fact was that Jia Gongyan was a Confucian scholar while Li Chunfeng more or less was not.

Commentary: Robert MIDDEKE-CONLIN | Université Paris Diderot - Paris 7, France

S045-B. How did actors compute with measured numbers? Part 2

Mon 22 July, 14:00–15:30 ▪ Roscoe 1.007

Chair: Karine CHEMLA | European Research Council, CNRS & Université Paris Diderot - Paris 7, France

John WEE | University of Chicago, United States

Measurements in Babylonian drawings of planets and star constellations

My paper examines several drawings of Babylonian planets and star constellations in tablets from the Seleucid period, which represent part of my ongoing project on the micro-zodiac. I clarify certain misunderstandings in Weidner's study of these tablets (1967) concerning the notion of "micro-decans," numbers assigned to lengths of daylight, and in particular the role of measurements in the positioning of planets and constellations.

In these drawings, constellations sometimes replicate stars found in other depicted constellations, and their sizes are out of proportion to each other. More curiously, the orientations of constellations are mirror images of those actually observed from the earth's perspective, so that the drawings cannot be understood as direct depictions of any celestial scene. I propose that these drawings were constructed using a horizontal scale, not of spatial distances, but of temporal measures. Below the drawings, the tablet's width is divided into twelve equal columns, each devoted to written discussion on a micro-zodiac sign ($2\frac{1}{2}^\circ$) that represents the twelfth-part of a single zodiac sign (30°). These columns do not only partition the written text, but also constitute the divisions of a horizontal axis at the base of the drawing. In addition, some drawings further divide their horizontal axis into thirty units (1° each) corresponding to the 30 days of an ideal Babylonian month. The tablets also mention months in which lunar eclipses occur, as well as numbers related to the length of daylight in specific months in Babylonian astrolabes. These features enable us to assign absolute (if ideal) date ranges to the horizontal axes of our drawings. I show that the left edges of constellation drawings are made to line up according to the ideal dates of their heliacal rising in the astronomical compendium MUL.APIN. The drawings, in effect, represent *temporal* intervals between dates as the *spatial* dimensions of a celestial scene. The tablet convention of numbering dates from left to right resulted in the mirror reversal of star constellations in our drawings.

The planets (moon, Jupiter, Mercury) in our drawings provide independent verification of my proposed scale, since these planets do not move like the fixed star constellations and were not positioned using the same method. Weidner earlier noticed that the planets are depicted in their "house of secret" positions, which correspond to the Greek *hypsomata*. While Babylonian texts do not define these positions precisely, Greek texts allow us to locate *hypsomata* in terms of degrees within a zodiac sign. The planets in our Babylonian drawings, on the other hand, correspond to "dates" that can be related in linear equation to the degree positions of Greek *hypsomata*.

ZHENG Fanglei | Fudan University, China

The problem of finding values in measurements and the use of different forms of fractions in the *Liber Abaci* of Fibonacci

The variety of the forms of fractions in the *Liber Abaci* might be a surprise to modern readers. Although it is not difficult to sum up the meaning of these forms, the reasons for the 'creation' or application of these forms are not very well studied. The author of the English translation of the *Liber Abaci*, Sigler, was content to suggest a reason for the usage of only one form. A fraction taking this form has an integer followed by a long fractional bar (I suggest to read the fraction from the right to left in *Liber Abaci*), and there are several numerators above the bar, opposite to the denominators of the same amount under the bar. I

mark here this kind of fractions in the case of two pairs of numerators/denominators by " $[q,p]/[n,m] + a$ ", which is equal to $a + [(n \times p + q) \div (m \times n)]$. According to Sigler, the choices for values of m and n might have been subjected to the measurement units concerned. Sigler gives two examples, which I sum up as follows: 2 pounds 7 soldi 3 denari in twelfth century Pisa could be written as " $[3,7]/[12,20] + 2$ " pounds (equal to $2 + [(12 \times 7 + 20) \div (20 \times 12)]$ pounds), since 1 pound values 20 soldi and 1 soldo values 12 denari. When the measurement units are in a decimal system, Fibonacci wrote what Sigler described as 'decimal fractions', such as what we find on page 93 of Boncompagni's 1862 edition: " $[3,3]/[10,10] + 18$ " bizantii (equal to $18 + [(10 \times 3 + 3) \div (10 \times 10)]$ bizantii, i.e. 18.33 bizantii), which represents 18 bizantii and " $[3]/[10] + 3$ " (i.e. 3.3) miliarenses. However, this explanation does not cover all forms we encounter in the *Liber Abaci* and these other forms, whether more or less complex, need further, more sophisticated explanations. Moreover, Sigler's explanation touches on only the representation of fractions. Thus, the impact of a fraction's representation on the rules of calculation itself needs study. The present research aims to analyze the use of different forms of fractions in the *Liber Abaci* in the solution of the problem posed on values in measurements rather than on abstract numbers in order to reveal certain relationships between the practical facet and the theoretical facet of the knowledge on fractions presented by Fibonacci in his *Liber Abaci*.

Dominique Tournes | University of La Reunion, France

Measurement and the price of wood in France around 1800

The scholarly books of mathematics from the 18th and 19th centuries, those on which historians of mathematics have so far focused primarily, reflect only partially the computation practices that were in use in various professional milieus. Centered on the benefits of decimal fractions and logarithms, these books certainly fitted the needs of professional mathematicians and astronomers, but certainly not those of bankers, merchants, artisans, workers and peasants. Today everyone uses the decimal system, has received basic education in mathematics and owns an electronic calculator, so it has become almost impossible to perceive the difficulty of calculations underlying the daily transactions of the 18th century. The numerous non-decimal measurement units specific to each country, each region or each city, led constantly to tedious problems, simultaneously requiring measure conversions and currency conversions, and also to highly technical operations. In addition, practices of counting and measurement could vary according to the professions, especially according to whether they needed exact results or just more or less crude approximations. This situation resulted in a multiplication of books of "comptes faits" – as they were called in France – with a general or specialized scope, as well as of many numerical and graphical tables to facilitate daily calculations. These works regularly define mathematics as composed of arithmetic, i.e., measurement of discrete quantities, and geometry, i.e., measurement of continuous quantities. This view of mathematics as entirely organized around the concept of measurement and its applications in everyday life deserves attention. The usual distinction between abstract numbers and measured numbers is magnified here by the omnipresence of 'complex numbers', that is to say numbers that express at the same time several kinds of units depending in a non uniform fashion on each other. Also observed in these books is a constant interaction between different mathematical objects in a process of mutual reinforcement and popularization: whole numbers, fractions, decimal fractions, logarithms, linear scales, tables, charts. We finally meet there an ongoing effort to ensure that the concepts and basic operations of calculation become accessible to a large audience who did not receive a high level of mathematical education or received no education at all. After a brief general overview, these issues will be illustrated by a case study on the measurement of wood and the calculation of its price in France around the year 1800, certainly an important and significant problem if one believes the many specialized books which were published at the time on this peculiar subject. We will try to identify the different groups of actors involved in

the production and trade of wood, their practices and instruments of measurement and calculation, and their specific mathematical knowledge.

Commentary: **Agathe KELLER** | Université Paris Diderot - Paris 7, France

S045-C. How did actors use and discuss measuring units?

Mon 22 July, 16:00–17:30 ▪ Roscoe 1.007

Chair: **Christine PROUST** | Université Paris Diderot - Paris 7, France

Annette B. VOGT | MPI for the History of Science, Berlin, Germany

Measured quantities and their uses: the development of statistics in Berlin, 1886-1945

Measured quantities and their uses - The development of statistics in Berlin (1886-1945) Annette B. Vogt The discipline social statistics was well developed in Berlin, from 1886 onwards at the Berlin University - when the economic-statistical seminar (Staatswissenschaftlich-statistisches Seminar) was founded -, and from 1906 onwards also at the Berlin School of Economics (Handels-Hochschule). Furthermore, in Berlin were several statistical offices, which were called bureau until late 19th century. In 1805 the statistical bureau of the Prussian country (Königlich Preußisches Statistisches Bureau, 1805-1934) was opened. In 1862 the statistical office of the town Berlin was established (Statistisches Bureau der Stadt Berlin, 1920-1945 von Groß-Berlin) which was the first office of a town in Germany. In 1872 the statistical bureau of the German Empire (Kaiserliches Statistisches Amt, 1918-1945 Statistisches Reichsamt) was established. In comparison, mathematical statistics was developed to a much lesser extent. The purposes of these statistical offices were the collection of data and to measure the socio economic variables like economic growth, levels and rates of the economic growth, inflation, unemployment etc. to get measured quantities (statistical information) about the economy and the society of their town (Berlin), the country (Prussia) and the state (the German Empire). In my paper I will discuss the following questions: How these purposes did influenced the development of statistics in Berlin at the Berlin University and the Berlin School of Economics from 1886 until 1945? Did measurement as such exist in economic statistics, and what was meant "to measure the socio economic variables" at that time? How statistics was taught and by whom at the Berlin University (1886-1945) and at the Berlin School of Economics between 1906 (from 1935 until 1945 it was named Business School (Wirtschafts-Hochschule)) and 1945? The professors, teachers and lecturers belonged not only to the staff of the Berlin University and the Berlin School of Economics, but were also employed in the different statistical offices in Berlin, others were working in insurance companies or unions. How the topics of lectures and the topics of publications were changed during this period, especially after 1933 because of the Nazi regime, when many important economists, statisticians and mathematicians were forced to leave Berlin resp. Germany and had to go into Exile. if possible - into symposia S 045

Jane WESS | Independent scholar, United Kingdom

Measurement, mathematisation and authority: the case of water and wind power

This paper explores the tentative steps towards power comparisons in the early to mid 18th century, focussing on the mathematisation of wind and water power, and the attempts to ground this old technology into a new Lockean philosophy. In particular it will consider the work of John Theophilus Desaguliers, but also touch on that of Colin McLaurin, Daniel Bernoulli and others. It will consider the establishment of the authority of measurement, the search for common measures of power between men, horses and machines. It will look at the impetus to bring this area of

technology under a consistent mathematical umbrella, imposing order on a range of previously unrelated activities. It will also demonstrate the emerging role of mathematics in contrast to craft skills, sometimes supportive, sometimes challenging, but relying on a new approach to old issues. Desaguliers marks out the boundary of his territory thus in 1734: 'Neither do I here take notice of any of the laborious operations of handy-craft trades because some men are much more dextrous than others and the same man by long use becomes so perfect in one way of working, that by an acquired sleight of hand he shall do twice the work that an inexperienced person can do, and yet not employ half so much strength, but this is properly craft and not labour which last was all I meant to consider here'. However, while he did not want to stray into territory over which there was little control, the rapid increase in the use of machines, largely relying on water power, meant he and his contemporaries were in a position to exert influence, in spite of the uncertainty regarding fundamental concepts and the lack of closure regarding the application of mathematics. The connection between the measurement and the mathematisation is complex in this period, and as expected, does not follow the suggested path of Whig history or the Platonic ideals of the 'scientific method'. The paper will be illustrated by models and archive material from the collection in the Science Museum, London, some used to demonstrate direct comparisons between different power sources. The contemporary models will be viewed in the light of the dissemination of experimental philosophy in the early to mid 18th century, and its connection with the developing technology. Later models will be contrasted as items in a museum setting for the general consumption of scientific principles.

Paulami GUHA BISWAS | Jawaharlal Nehru University, India

How the roads were measured in early colonial India

This paper explores the various stories around measurement and calculation of distances of the roads in early colonial India. It focuses on the mathematical facets and statistical problems involved in the shift from 'kos' (Indian unit of measurement) to 'mile' and shows how the statistical tables and distance charts were produced by the surveyors and administrators. Often the time length of journey was converted into distance leaving some disturbing distance charts in which 6 'koses' varied from 14 to 15 miles, 5 'koses' from 13 to 15, and 7 'koses' from 18 to 21 miles. Highlighting on a certain incident in the Postal Department, this paper would show how the colonial administrators dealt with such confusing and fluid statistics. Varieties of distance charts flowed into the Postal Department in which the same distance from one place to another differed even upto 40 miles sometime. But still there was a relentless attempt on the part of the colonial state to fix the distances, to finalize the charts, to produce the English unit 'mile' as static and standard. This paper would like to explore these early moments of adaptation of the measuring unit 'mile', how it replaced the earlier prevalent unit 'kos' and how its claim of authenticity and 'scientificity' succumbed to a drastic failure. The numbers engraved on the milestones were all fallacious, the statistical charts produced as 'final' in the Postal Department hardly showed any 'correct' distance. This paper would explore these series of discrepancies that stormed the postal system in India in the early 19th century. Partially agreeing or disagreeing with scholars like Ian Hacking, Theodore M. Porter, M. Norton Wise, I would try to trace the ways through which statistics and mathematics entered the realm of social science practices, how the payment charts of the *dak* bearers or postal carriers had essentially to be commensurate with the distance charts and how the obligation to fix the distance charts derived from that urgency. The fluid unit 'mile' could hardly address these problems though it survived until the metric system was introduced in India along with the arrival of the railways in mid 19th century. The history of roads therefore is closely related to the history of the measuring unit 'mile' and the mathematical problems embedded in it. This paper intends to look into the ambiguity and confusion around mathematical data from which the tentative notion of 'exactness' derived in India.

Discussion

With commentary from the symposium organisers

S046. Visual communication in early-modern to modern learned journals

Tue 23 July, 09:10–12:40 ▪ Roscoe 1.008

Symposium organisers:

Maria CONFORTI | Unità di Storia della Medicina - Sapienza Università di Roma, Italy

Jeanne PEIFFER | CNRS, France

Symposium abstract

The study of visual representation and of circulation of knowledge are among the most active areas in history of science today. This symposium aims to bring together scholars from both fields to deal with the production, circulation and use of visual representation in scholarly journals from the late 17th to the early 19th century. The presence of images, maps, graphical devices, diagrams, etc. in learned journals deserves a closer historical analysis. Visual representations will be here considered as instruments of communication, but also as part of a process of knowledge-making, the traditional distinction between the production and the communication of knowledge being often blurred, and even more so if the learned press is concerned. What is specific about visual representations in periodicals? Images can be ordered in series and become themselves 'periodical'. A specific circulation of images takes place, with exchanges between books and journals, and from journal to journal. One of the crucial questions is how journalists deal with these images, how they use them, and to what purpose.

Images do communicate scientific contents to various audiences. Are they addressed to different layers of the target audience of a journal? How can we describe the interplay between images and text in periodicals? Are they meant to illustrate or reinforce textual statements, to make them plausible, or to advertise objects of knowledge - books and instruments, practices and procedures? We can also ask if visual representations stand by themselves, encapsulating a different scientific knowledge than described in the text they are inserted in. What kind of knowledge is this? Working knowledge for savants, information for the educated reader or for the practitioner, consumer-oriented knowledge? Are they considered to speak by themselves or do they need to be spoken about in captions, legends, comments, et al.? Do we have witnesses to their uses in actual scientific practice?

Studying the interplay between journals, especially via translation processes, we will question the fate of visual aspects during this processes. If images are artefacts produced by visual cultures of knowledge production, we need to understand if an adaptation to a new audience or culture is required, and how it is achieved. Finally, we are also interested in the making of visual standards. Does each journal create its own or are they bound to specific audiences, times, or disciplines?

The meeting will afford the opportunity for a presentation of selected case studies, together with the discussion of methodological aspects.

S046-A

Tue 23 July, 09:10–10:40 ▪ Roscoe 1.008

Chair: Jeanne PEIFFER | CNRS, France

Charlotte BIGG | Centre Alexandre Koyré, France

Visually communicating astrophysics in nature

The early astrophysicist and self-publicist extraordinaire Norman Lockyer frequently used the journal *Nature*, which he had help found in 1869 and edited until his death in 1920, to expound his own theories, report on his work and send news home while on expeditions. He (like others) also very frequently reused his visual materials in other periodicals and books, for lectures or exhibitions. I look into the particular visual culture developed by Lockyer in *Nature*, its evolution through time (at a time of rapid development of techniques of photographic reproduction) and in comparison with other periodicals and practitioners, in order to estimate the extent to which he made his mark (or failed to) on an emerging visual culture characteristic of the new field of astrophysics through his control of one important periodical of the time. The circulation of images across print media, exhibitions and performances reproduced and multiplied the city- and world-wide circulation of Lockyer himself, helping consolidate his persona and the identity of his burgeoning field.

Elena CANADELLI | Università degli Studi di Padova, Italy

Illustrating nature in early nineteenth-century learned journals

The paper aims to investigate the role of images and plates in European natural sciences journals of the first half of 19th century. Visual practices played a central role for naturalists in the process of knowledge-making, explaining and communicating nature to an audience of scientists, amateurs, academics and intellectuals. The end of 18th century and the early 19th century was a period of relevant growth for zoology, botany, geology and paleontology, a time in which new discoveries and new theories entered the arena of ideas, before the ascension of Darwin's evolutionism in the second half of the century: thus, it is important to understand in which way naturalists used images and how they considered them, since they were an integral part of the tools displayed in scientific articles to argue and convince the scientific community. Naturalists didn't use only descriptions and observations, but also representations, drawings, lithographs or engravings considered as specific and stratified scientific data as the text. Often they presented in their papers images taken from other authors' articles or books to explain their theories, other times they realized special plates to synthesize their descriptions. Therefore, studying the circulation and diffusion of some of these images means to draw a visual history of natural sciences in an age of great expansion. The paper will consider examples taken from learned journals of the end of 18th century and the first half of 19th century such as the French «Annales des Sciences Naturelles», the Italian «Memorie della Reale Accademia delle scienze di Torino», or the English «Annals and Magazine of Natural History».

José BELTRAN | European University Institute, Italy

On the ambiguous nature of the American cochineal: images, microscopy, and argument in the late seventeenth-century public sphere

This paper addresses the question of visual communication in early modern learned journals. Paradoxically, the case analysed to explore this question concerns an image that never existed. In 1694 and 1703, the French naturalist Charles Plumier (1646-1704) published two articles on the American cochineal. One of the most valuable products in Transatlantic trade, the cochineal was still the object of debate by European naturalists, who were undecided whether it was an insect or the seed of a plant. With these two articles, Plumier entered into, for the first and the last time, a public scientific controversy. As a result of his observations with the microscope, he became convinced of the animal nature of the cochineal, yet he did not use any kind of picture to support this claim in his articles. The lack of any kind of visual argument is especially striking in the case of a naturalist whose notes include around three hundred drawings, and whose printed works were mainly composed by engravings. The question is thus why a scholar like Plumier, who observed and conceptualised nature through the practice of drawing, did not use images to support his claims in the context of a public debate such as that over the nature of the cochineal.

I will use this example to consider the ambiguous status of the visual in scientific controversies: while eyes were useful for understanding nature in a private sense, images do not seem to have been viewed as reliable evidence in a public debate. The paper attempts to explore, by means of this case study, the particular functions with which images were endowed in the public sphere, and to examine these in the context of the world of learned journals. My aim is to explore the ambiguity of the visual in the early modern period, as well as the uncertainties naturalists had to face when trying to construct a reliable account of nature.

Maria CONFORTI | Unità di Storia della Medicina - Sapienza Università di Roma, Italy

Illustrating pathological anatomy in the *Ephemerides Naturae Curiosorum*

The journal of the Academia Leopoldina Naturae Curiosorum, beginning in 1670, rapidly became one of the main European forums for exchanges in the field of medicine and related disciplines. The paper will take into account the way anatomical articles were illustrated in the second half of the 17th century, with a particular attention to representations of pathological findings. This will allow to examine changing patterns of pathological models and representations.

S046-B

Tue 23 July, 11:10–12:40 ▪ Roscoe 1.008

Chair: Maria CONFORTI | Unità di Storia della Medicina - Sapienza Università di Roma, Italy

Meghan DOHERTY | Berea College, United States

The power of images in early-modern learned journals

In the March 30, 1665, issue of the *Journal des Scavans*, the editor took notice of a new English enterprise: the *Philosophical Transactions*. This marked the first in a series of references to the journal that at the time was affiliated with, but not officially produced by, the Royal Society of London. This paper examines the cross-pollination between the *Philosophical Transactions* and the *Journal des Scavans* with a specific focus on the role of the visual as an open form of communication, which overcomes the linguistic barriers implied by journals published in vernacular languages, rather than technical Latin. While scholars, such as Anthony Turner, have written on the attempts made to translate the *Philosophical Transactions*, little work has been done on the transmission of images between the two journals. Studying how these articles were illustrated and how the illustrations related to the texts lends insight into the powers of visual images within the larger missions of these societies. This paper studies visual astronomy in order to examine how the powers of the printed image respond to the specific communicative demands necessitated by these active societies.

Samuel GESSNER | Centre for the History of Science and Technology (CIUHCT), Portugal

The journals and the instrument maker: Butterfield's instruments explained and advertised in the *Journal des sçavans* (1677, 1678, 1681) and the *Philosophical Transactions* (1678)

The earliest known notice of the mathematical instrument maker Michael Butterfield (ca. 1635-1724) comes from articles published in the early periodicals *Journal des Sçavans* and *Philosophical Transactions*. A levelling instrument with telescopic sights, the production of a microscopic lens and a compact odometer gear, all made at the Faubourg Saint-Germain in Paris are presented. Later Butterfield becomes one of the most successful makers of his time in Paris, manufacturing on behalf of Cassini a silver planisphere to be offered to Louis XIV (1678-79), and many more commissions by members of the

Académie des Sciences. The upcoming maker's ambition to advertise instruments of excellence and to establish priority for novelties during the late 1670s seems to match the journalists' wish to provide their readers with the latest significant inventions. What can we learn from the way the instrument maker and the authors of the notices handled the succinctness typical of these journal articles? In these densely technical texts the role played by the included engravings is crucial: their place (or their absence) needs to be examined. Thereby the particular focus will be on the specialized knowledge they presuppose both from the draftsman and the audience.

Jeanne PEIFFER | CNRS, France

Changing images of the rhinoceros, from Dürer to the *Philosophical Transactions* and its French translation

In the wider scope of the interplay between journals, this talk will present a case study on the circulation of images and the changes they undergo when circulating over time and from one geographical area to another. When James Parsons, FRS, gave "the natural history of the rhinoceros" in a 1743 issue of the *Philosophical Transactions*, he discussed a collection of figures of the rhinoceros inspired by Albrecht Dürer's famous 1515 drawing and woodcut of the animal, and opposed it to the detailed description of an individual exhibited in London in 1739. When in 1759, the French translator, Pierre Demours, was confronted with Parson's tables, he found the London rhinoceros not at all resembling the specimen he had seen in Paris in 1749. He added a representation of the Paris rhinoceros and argued about the differences between the London and Paris specimen. The lecture will focus on the origins of the various representations, their changes and the arguments given to explain these changes. Do they adapt to a different level or horizon of knowledge? Do they take into account the (visual) culture of a new audience? These are some of the questions asked.

S048. Putting Chinese natural knowledge to work in the long eighteenth century

Thu 25 July, 09:10–10:40 ▪ Uni Place 4.212

Symposium organisers:

Alexandra COOK | University of Hong Kong, Hong Kong

Nicolas ROBIN | University of Teacher Education St. Gallen, Switzerland

Symposium abstract

This symposium looks at the application of Chinese natural knowledge in a range of fields during the long eighteenth century.

Much scholarly attention has been devoted to the early-modern European interest in Chinese philosophy, institutions, history, language, and gardens; similarly, the activities of the Society of Jesus in China, including its work in astronomy, geography, and mathematics, have received considerable attention. However, there has been less sustained research on the ways in which China contributed to natural knowledge even when contact with outsiders was limited. For example, it has been assumed that botanists of the 'centre' such as Linnaeus named Chinese and other plants of the 'periphery' with no regard to local Chinese understandings, but this was not in fact the case; a local understanding of a plant's use, as in the case of ginseng, could still become a global understanding. A complex process of translation and transformation of natural knowledge was therefore underway even in the relatively limited encounters that were possible in the mid-eighteenth century.

The papers offered in this symposium examine how Chinese natural knowledge came to be known and used in a range of eighteenth-century European sciences: alchemy, pharmacology, medicine, natural history, geography and botany.

Chair: Hanna HODACS | Royal Swedish Academy of Science, United Kingdom

Alexandra COOK | University of Hong Kong, Hong Kong

Putting Chinese natural knowledge to work in an eighteenth-century Swiss canton: the case of Laurent Garcin

This paper takes as a case study the experience of the eighteenth-century Swiss physician, Laurent Garcin (1683-1752), with Chinese medical and pharmacological knowledge. A Neuchâtel bourgeois of Huguenot origin, who studied in Leiden with Hermann Boerhaave, Garcin spent nine years (1720-1729) in South and Southeast Asia as a surgeon in the service of the Dutch East India Company. Upon his return to Neuchâtel in 1739 he became *primus inter pares* in the small local community of physician-botanists, introducing them to the artificial sexual system of classification. He practiced medicine, incorporating treatments acquired during his travels, taught botany, collected rare plants for major botanical gardens, and contributed to the *Journal Helvétique* on a range of topics; he was elected a Fellow of the Royal Society of London, where two of his papers were read in translation and published in the *Philosophical Transactions*; one of these concerned the mangosteen (*Garcinia mangostana*), leading Linnaeus to name the genus *Garcinia* after Garcin. He was likewise consulted as an expert on the East Indies, exotic flora, and medicines, and contributed to important publications on these topics.

During his time with the Dutch East India Company Garcin encountered Chinese medical practitioners whose work he evaluated favourably as being on a par with that of the Brahmin physicians, whom he particularly esteemed. Yet Garcin never went to China, basing his entire experience of Chinese medical practice on what he witnessed in the Chinese diaspora in Southeast Asia (the 'East Indies'). This case demonstrates that there were myriad routes to Europeans developing an understanding of Chinese natural knowledge; the Chinese diaspora also afforded a valuable opportunity for comparisons of its knowledge and practice with other non-European bodies of medical and natural (e.g. pharmacological) knowledge.

Bettina DIETZ | Hong Kong Baptist University, Hong Kong

Pehr Osbeck's trip to China, 1750-52, and information management in eighteenth-century natural history

As chaplain on a ship of the Swedish East India Company, Linnaeus' student, Pehr Osbeck, reached south China in 1751. Wherever circumstances permitted, he went on land to collect natural objects and to make natural history observations about a region that was a *tabula rasa* for natural history in general, and the project of Linnaean botany in particular.

This paper will address how a characteristic feature of the knowledge-making process of eighteenth-century natural history was reflected in the publication of the accumulated material; namely, the insight that in the rapidly growing field of natural history, and botany in particular, projects with large regional, let alone global, aspirations were, by their nature, works in progress. They could not be accomplished by an individual scholar, nor achieved in a single, one-off publication because of the continuing stream of new information and the many inevitable errors that constantly demanded correction.

Hjalmar FORS | Uppsala University, Sweden

Different orders of secrets? German perceptions of Chinese alchemy and pharmacy

This paper will discuss perceptions of Chinese alchemy and Chinese medicinal plants among Europeans engaged in alchemy in an around medical and pharmaceutical professions. It is concerned with views of Chinese trade- and medicinal secrets, alchemy, and extraordinary inventions. While the Jesuits were prolific gatherers and publishers of information, their version of China was not the only one propagated in early modern Europe. The study will concentrate mainly on Protestant, i.e. Lutheran, actors.

German and Scandinavian alchemists, apothecaries, physicians, surgeons and artisans travelled all over the world. They worked for the Russian state, and manned the ships of the Dutch East India Company. The paper will examine to what extent the understanding of Chinese natural knowledge among these groups was conditioned and created by European perceptions, priorities and pursuits. Did cultural conditioning prevent early-modern Germans and Europeans at large from accessing, or even discussing the vast and influential alchemical traditions of East Asia and China on any deeper level?

Alexander STATMAN | Stanford University, United States

The Enlightenment story of the Chinese discovery of America

Readers of the *Mémoires* of the *Académie royale des Inscriptions et Belles-Lettres* for 1761 must have been surprised to read that "Chinese vessels made the voyage to America many centuries before Christopher Columbus." The academician Joseph Deguignes of the *Bibliothèque du Roi* had concluded from his wide reading of Chinese historical and geographical works that the mythical land of "Fou-sang," or *Fusang* 扶桑, could be nothing other than the Northwest coast of North America, only recently charted by French and Russian navigators. Based on the account in the seventh-century *History of the Southern Dynasties* 南史, Deguignes reported that while Europe lay in the darkest thralls of the middle ages, Chinese merchants and missionaries were carrying on an active commerce with Native American peoples. Monks had brought Buddhism to the New World, where the weather was mild, food and game abounded, and the *Fusang* tree provided for daily needs. The inhabitants were highly civilized: they knew the secrets of the wheel and they manufactured silk and paper, they had complex marriage laws and a penitentiary system. Adding narrative color and scientific legitimacy to Deguignes's account, the cartographer Philippe Buache drew an original map on which he charted the epic medieval Chinese journey to the coasts of North America.

The Enlightenment story of *Fusang* shows how French thinkers put Chinese geography to work and why they thought it mattered. Deguignes's report was taken up for consideration by the leading French geographers of his day, including Buache, Joseph-Nicolas Delisle, and Jean-Baptiste Bourguignon d'Anville. They debated the value of Chinese geography, from the cosmography of the *Classic of Mountains and Seas* 山海經 to the mathematical surveying techniques in the *Classic of Documents* 書經. Conclusions drawn from the Chinese tradition were put to work in European theories on the local geography of the Pacific Rim, the organization of the continents, and the propagation of societies. At stake was nothing less than the universal progress of natural philosophy, which the story of *Fusang* was understood both to narrate in its spread around the world and to exemplify in contributing to geographical knowledge. In France, *Fusang* thus took on new meaning, informing an Enlightenment theory of the development of human civilization in time and space that the medieval Chinese monks who supposedly reported it could never have imagined.

S049. Science and optical media: imaging technologies,

knowledge formation and the rise of the scientific imagination

Sat 27 July, 14:00–17:30 ▪ Uni Place 3.204

Symposium organisers:

Margarida MEDEIROS | Universidade Nova de Lisboa, Portugal

Anthony ENNS (non-participant) | Dalhousie University, Canada

Symposium abstract

This symposium will consist of two 90-minute sessions with 3-4 speakers in each session. The first session, "Optical Media and Scientific Practices," will examine the use of optical media in the construction and corroboration of scientific facts. The use of lenses, mirrors, and prisms, for example, not only transformed the scientific understanding of light, vision, and optics but also generated a tremendous wealth of scientific knowledge concerning both the infinitesimally small and the infinitely vast. The development of optical storage media also transformed the way in which scientific facts were ascertained and substantiated. The indexicality of the photographic image, for example, enabled it to function as concrete evidence of the data it recorded, even when the images it produced could not be perceived by the human eye. The case studies provided in this session will thus be particularly concerned with the following topics: the scientific understanding of light, vision, and optics; the development and application of optical media as scientific instruments in industry, technology, medicine, and science (including microphotography, astrophotography, x-ray photography, computed tomography, etc.); and the evidentiary value of scientific images, particularly with regard to the history of scientific frauds, hoaxes, and pseudosciences.

The second session, "Scientific Images and the Scientific Imagination," will examine the influence of scientific images on the work of creative artists, writers, and filmmakers. The images generated by scientific researchers have inspired some artists to revise their notions of realism and verisimilitude, while other artists have been inspired to imagine fantastic scenarios based on the new possibilities opened up by scientific visualizations. The case studies provided in this session will thus be particularly concerned with the following topics: the use of optical media to communicate scientific knowledge to the general public; the aesthetics of scientific images, from meteorological charts to brain maps; and the impact of scientific images on art, literature, and film.

By bringing historians of science together with art historians, literary critics, and film scholars, this international and interdisciplinary symposium will help to trace the significance of optical media both within and beyond the limits of scientific practice, and it will help scholars working in different fields, historical periods, and national contexts to recognize similar interests, goals, and concerns.

S049-A. Optical media and scientific practices

Sat 27 July, 14:00–15:30 ▪ Uni Place 3.204

Chair: Margarida MEDEIROS | Universidade Nova de Lisboa, Portugal

Teresa MENDES FLORES | CENTRO DE ESTUDOS DE COMUNICAÇÃO E LINGUAGENS, Portugal

Medical photography and the tradition of the demoniac body

This communication will examine how an enduring tradition of pictorial representation of demoniac bodies, coming from paintings, engravings and architectural reliefs, back to medieval ages up to romantic aesthetics in the XIXth century, has directly influenced the medical gaze and its use of photography, and instilled the concept of objectivity. This concept has emerged contesting mythology and the imagination. However, we will show how imagination was not, in fact, dismissed and played an important part of knowledge construction of all times. We will take into consideration some photographic examples of the portuguese medical photography collected by our research project on the Visual Culture History of Portuguese Medical Images and look at it through this demoniac tradition. Some of these images are also connected with colonial medical photography and its representation of black people.

Fernando CASCAIS | New University of Lisbon, Portugal

Imagining madness: images of the insane in a Portuguese asylum

Within the scope of the R&D Project "History of the Visual Culture of Medicine in Portugal", coordinated by the paper's author, two large sets of photographs were retrieved at the oldest psychiatric hospital in the country, the Hospital Miguel Bombarda. The first set dates back to the late nineteenth and early twentieth century (before 1910) and the second and largest set dates roughly from the 1920s and 1930s. The authors are unknown and the medical reasons for taking them can be inferred from some of the clinical histories and the admission records. They aim at portraying schizophrenia, neurosyphilis, chronic alcoholism, sexual perversion, hysteria, microcephaly and other congenital deformities, meningitis, etc. They belong to the last days of golden age of the "grand renferment" described by Michel Foucault, in the eve of the psychopharmacological revolution that brought about radical changes in therapeutics and care of mental patients, as well as a turn in societal attitudes towards them. They are reminders of a world that we are ready to regard as definitely not ours anymore, and to which we tend to look back judgmentally with dismay, sorrow and horror. More precisely, those photo shots document the shift in the history of psychiatry between therapeutic nihilism and the utopian social hygienism that sought effectiveness by resorting to the use of violent treatments of the mentally ill, from malariotherapy to insulin shock, from electroshock to psychosurgery, against the background of forced confinement and restraint. In Portugal, the use of medical photography can be traced back to the reception of both Charcot's Iconographie Photographique de la Salpêtrière, of which first editions can be found in medical libraries, and the widespread use of the "bertillonage" techniques in forensic medicine. The use of photography in medicine, having enjoyed great favor as a tool to reveal the invisible (the optical unconscious) to the medical gaze, by capturing the reality of symptoms and stigmata finally frozen in truthful, objective proofs and thus replacing the rhetorics of narrative descriptions and speculations, has lost credibility and authoritativeness as medical styles of reasoning, concepts of health and disease and societal and political attitudes changed. However, the photographs in question can now be retrieved not only as icons of madness and deviance, but above all as illustration of the imagining of the homo demens by the medical gaze.

Victor FLORES | Universidade Lusófona de Humanidades e Tecnologias, Portugal

Stereoscopic photography: an archaeological display of twenty-first-century imagery

The joint pathway followed by stereoscopy and photography in their first fifty years earned them expression and popularity, allowing their histories to be confused. One of the most common early ways of experiencing photography was through stereoscopic devices, most of them invented by the studies physiology devoted to vision between 1820 and 1840 regarding binocularity. On the other hand, what enabled the public success of the stereoscope was its association with photography. By applying plates, glasses or photographic papers to the stereoscope, a

hybrid medium that combined two modern inventions was created. In spite of their distinct cultural heritages, the association of these inventions was able to satisfy some of the main visual needs that are still present, and clearly reinforced, in our current visual culture. The desire to peek, to touch and to experience immersive environments can be seen, we argue, as an archaeological fulfilment of some of the most required features of our imagery in the 21st Century.

S049-B. Scientific images and the scientific imagination

Sat 27 July, 16:00–17:30 • Uni Place 3.204

Chair: Fernando CASCAIS | New University of Lisbon, Portugal

Margarida MEDEIROS | Universidade Nova de Lisboa, Portugal

What's the value of a shadow? Rorschach, X-rays and the fantastic echoes of the images of science

The question of the epistemological status of the image, mainly the lens-based image, is something that was intensively discussed through the turn of the century (Daston and Gallison 1995 and 2001), as images were feeding what should be called mechanical objectivity. With the discovery of X-rays in 1896, a new kind of scientific image saw the light. An image that crossed the body and showed the skeleton, or that showed the lungs in some sort of blurred and encoded drawing, which was the privilege of skilled doctors to decipher. This kind of image, which simultaneously showed too much (showing the interior of the individual) and too less (because it needed certain skills to interpret them) was making success in popular imagination and a lot of contradictory concerns were explained very sharpened in Thomas Mann's *The Magic Mountain* (1912) (and also, indirectly, in Wells' *The Invisible Man* (1897) and in popular movies from the first decade (G. Smith, Emile Cohl with "The x-rays glasses", 1907). But the expansion of x-rays in the medicine field was quite contemporary of the invention of a sort of blurred drawings (inkblots) designed by Rorschach in 1921 to interpret the soul. Although Rorschach inkblots are drawings, and so they don't have any epistemological status in themselves, they are supposed to get some truth from the individuals interior, expressed in the response, supposed very well measured in the scientist notebook, to those blurred images. In some way they are quite the inverse of x-rays images which portray the interior as seen by a machine. In this paper we will underline how the problem of objectivity in science and in medicine turned, in the beginning of the xx century, to be seen as a discourse produced upon codes belonging to specialists which can decipher them, and this fact was decisive to rise in literary fiction as well in the movies (comedy and drama) all kind of unconscious fantasies and anxiety shared in popular culture. We will point out that precisely as scientific images became blind images to common knowledge (which today is still more complex, like magnetic resonance or TAC), and as their value increases within medicine discourse, they are more able to be taken as a stating point to fantasy.

Marília PERES | University of Lisbon, Portugal

Maria Estela JARDIM | Faculty of Science, University of Lisbon, Portugal

A fotografia na divulgação da ciência e do conhecimento nas exposições internacionais e universais do séc. XIX

O progresso, a indústria, a tecnologia, mas também o multiculturalismo e globalização caracterizam Exposições Internacionais de hoje mas também as que aconteceram desde à mais de um século e meio atrás.

Foi o príncipe Albert, marido da rainha Vitória, que teve a ideia de organizar, em 1851, a primeira grande exposição internacional para a exposição de produtos industriais, trazendo ao público a consciência

sobre o desenvolvimento tecnológico e científico da época. As grandes exposições do século XIX revelaram essencialmente o progresso industrial ligado à ciência e tecnologia de uma forma espectacular e sem precedentes.

A fotografia foi inventada na década de 1830, e desde então foi vista como um meio de representação objectiva e verdadeira. Textos e imagens dão-nos conta do progresso científico, por isso, com a invenção da fotografia a circulação do conhecimento científico em palestras públicas, sociedades científicas e exposições sofreu uma considerável modificação.

Na "Grande Exposição", como foi chamada a Feira Mundial de Londres de 1851, as imagens fotográficas faziam parte da exposição de muitos países, incluindo importantes exemplares de fotografias científicas na forma de fotomicrografias e fotografias astronómicas. Durante a segunda metade do século XIX, as exposições internacionais e universais exibiam fotografias como um meio para mostrar fenómenos e dados científicos, sendo por isso possível acompanhar o desenvolvimento das técnicas de fotografia e das suas aplicações na Ciência através do estudo de catálogos históricos e relatórios relacionados com estas importantes exposições.

Como muitos outros países, Portugal também participou nestas exposições internacionais e universais, mostrando o que era realizado no ponto de vista da fotografia artística, mas também das aplicações científicas dos seus mais prestigiados cientistas, através da fotografia. Pretende-se nesta comunicação discutir a contribuição portuguesa no contexto europeu.

Connecting science and knowledge through photography at the nineteenth-century universal and international exhibitions

Progress, technology, industry but also multiculturalism and globalization characterizes International Exhibitions today as it did more than a century and a half ago.

It was Prince Albert, Queen Victoria's husband, who had in 1851 the idea of organizing the first great international exhibition for the display of industrial products, bringing to the public the awareness for the technological and scientific development of the time. The Great Exhibitions of the 19th century showed essentially the industrial progress connected with science and technology in an unprecedented spectacular way.

Photography was invented in the 1830s; since then it was seen as a medium of objective and truth representation, showing nevertheless, certain mediation during its process. Texts and images give an account of the scientific progress; with the invention of photography the circulation of scientific knowledge in public lectures, scientific societies and exhibitions suffered considerable modification.

In the "Great Exhibition", as it was called the London World Fair of the 1851, photographic images were assembled from many countries, including important examples of scientific photographs in the form of photomicrographs and astronomical photographs. During the 2nd half of the XIX Century, International and Universal Exhibitions displayed photographs as a visual mean of showing scientific phenomena and data; it is possible to follow the development of the photographic techniques and its applications to Science through the study of historical catalogs and reports related to these important exhibitions.

As many other countries, Portugal also participated in these international and universal exhibitions, showing what was accomplished in the Art and Science of photography and its scientific applications by its most prestigious photographers

and scientists. In this paper these contributions will be discussed within the European context.

This presentation is based on work co-authored by Fernanda Madalena Abreu Costa.

S051. Population control and reproductive health rights in Cold War Asia

Tue 23 July, 09:00–12:30 ▪ Roscoe 1.007

Symposium organisers:

Aya HOMEI | University of Manchester, United Kingdom
Yu-ling HUANG | State University of New York at Binghamton, United States

Symposium abstract

The symposium engages with the Congress theme by examining the coproduction of science and politics in the domain of reproductive health and demography with a focus on Asia in cold war.

After WWII, western demographers promoted the idea of 'overpopulation' in Asia as a threat to world peace. This was a cold war statement. The symposium then asks, 'what cold war contexts subjected Asian populations to international surveillance and a focus of the international demographic enquiries?'

The cold war vision of population control hinged on the racial politics and the emerging world order based on a country's scale of economic development. How these factors served as a means to reformulate population policy in Asia in a postcolonial and postwar climate is another theme of the symposium.

International initiatives in Asia could not have been attained without the participation of local actors. As we aim to show, demographers in Asia internalized the western gaze and studied reproductive practices of the urban poor, labourers, and rural population in their countries. Presenters will also depict how the collaboration between international and Asian actors blurred the boundary between demography, policy-making and birth control initiatives.

Finally, we discuss the changing notion of reproductive health and rights in Asia resulted from the participation of demographers, in the post-Nazi world where demographic practices involving the promotion of coercive birth control were disguised as a contributory element to maternal health.

While our primary focus is on Asia, we aim at going beyond merely depicting locally-specific narratives. We attempt to: a) look at the ways in which cooperation and negotiations between Asian and western demographers and health campaigners could reflect forces of global bio-power in the cold war context and b) seek crossovers in Asia by asking if the international gaze contributed to the construction of Asian demographers' network.

S051-A. East Asia

Tue 23 July, 09:00–10:30 ▪ Roscoe 1.007

Chair: Aya HOMEI | University of Manchester, United Kingdom

Aya HOMEI | University of Manchester, United Kingdom

Cold War and US-Japan interactions for the understanding of Japanese population, 1945-1960

Amidst the shifting world order and an uncertain geopolitics surrounding the East Asia in the 1940s, the notion of population became subject to

reinterpretation, and the overpopulation of racialized and monolithic "East Asians" became problematized as it was considered to be jeopardizing global security. Specifically, pressed by the cold war exigencies of containment and American hegemony, white American commentators alarmed that social and economic chaos caused by overpopulation would make East Asia to succumb to Communism. In response, the Japanese government – still under the US occupation – quickly enacted birth control policies while the occupation authorities condoned the resurgence of birth control movement that had hitherto been suppressed due to its association with socialism.

In this context, leading demographers from the US and Japan began to conduct projects in order to understand the demographic trend of Japan and to test for the efficacy of certain contraceptives and the local birth control service within Japan. These projects, though seemingly independent from each other, were generally a result of cumulative interactions between American and Japanese advocates who, informed by the burgeoning cold war biopolitics, problematized the reproductive habit of certain segments of Japanese people; namely, the rural population, urban poor, and coal miners whose wives were relying on the company health insurance to have abortions. The presentation then analyzes a) ideas of race and class interwoven with the cold war politics, which undergirded the scientific projects as well as the US-Japan interactions within the projects, b) the role of the Japanese government and American philanthropists, most notably Clarence Gamble and the Rockefeller Foundation, in fostering scientific cooperation across the Pacific, and c) the significance of these elements for the formation of scientific knowledge on the population of Japan as well as for the shaping of images in the international scientific community regarding the reproductive habits of Japanese people.

KOHAMA Masako | Nihon University, Japan

Birth planning in socialist China: the case of two villages from the 1950s to 70s

With regard to family planning in China, the "one-child policy" is well-known. However, the promotion of birth planning in China actually began in the late 1950s. It was reinforced intermittently and led to the "one-child policy" in 1979. In my presentation, I want to analyze the process of popularizing birth planning in rural China, based on the field-work in two regions conducted by my research group.

The first, Q Village in Liaoning Province, Northeastern China, can be called a "model village" from the viewpoint of birth control advocates. In this village, contraception by IUDs was introduced in the 1960s, while sterilization came to be universally recommended to women of reproductive age in the 1970s. In the 1970s, the number of births indeed decreased so much so that many women gave birth to only two children. Birth planning was based on the primary health care provided by the village cooperative medical system and on the administrative system of the People's Commune. Q Village received good care from a female "barefoot doctor", while the women head of the production brigade enthusiastically supported birth planning. Women's leadership ensured gender sensitive mobilization, which resulted in the "successful" birth planning in Q Village.

In the other village, B Village in Hunan Province, Middle China, birth rates did not decrease as in Q Village, as many women gave birth to three or four children even in the 1970s. In B Village, the village leader was not enthusiastic with birth planning, and the modernization of childbirth was not going well.

In both villages, sterilization was monopolistically provided by the administrative and medical system of People's Commune. Thus, birth planning—that is, state intervention in reproduction—became a part of the administrative and medical system. This system actually made birth control technologies available for rural women who had previously had no access. Taking into account of their poverty, some villagers welcomed birth control. However, mobilization of birth planning gradually became stricter in the 1970s, and some women tried to resist it. The

government attempted to coerce birth control on women, but this was based on the unequal power relationships within the villages. But, my presentation shows that village women were not simply passive clients but active agents accepting or resisting the government policy, and changed their fertility patterns as a result.

Yu-ling HUANG | State University of New York at Binghamton, United States

State, US influence, and women's organizations: the politics of population and reproduction in post-war Taiwan

This article investigates the domestic and international factors that played a center role in shaping the politics of population and reproduction in postwar Taiwan. During the 1960s and 1980s, East Asian countries experienced dramatic reduction of fertility—a phenomenon that a *Lancet* article called “Reproductive Revolution in Asia.” The fertility rates of Taiwan had dropped from 6 to replacement level with three decades. Instead of explaining such a demographic transition to modernization and successful population policies, like population scientists suggested, this paper focuses on how the complex interactions among state agencies, women's organizations, and U.S. influence that made mass fertility control thinkable, desirable, and feasible. In this historical process, the autocratic nature of the Kuomintang (KMT) regime conditioned these actors' choices and activities. It also suggests that population and reproduction as a site to study the encounter of U.S. hegemonic influence and local realities during the Cold War years. This paper aims to enrich the global studies of reproduction and population control by highlighting the East Asian context.

S051-B. South Asia

Tue 23 July, 11:00–12:30 ▪ Roscoe 1.007

Chair: Yu-ling HUANG | State University of New York at Binghamton, United States

Rebecca WILLIAMS | University of Warwick, United Kingdom

Revisiting the Khanna Study: population control in postcolonial India, 1953-1960

My paper will examine the Khanna Study as a case-study of population control in postcolonial India. Operating on the Malthusian premise that 'overpopulation' was a social malady which could lead to famine, poverty, and civil unrest, the Khanna Study staff worked for seven years in a handful of villages in the Ludhiana district of Punjab to test the effects of a family planning program on the birth rates. Whilst the original study was conducted between 1953 and 1960, it was later made infamous by Mahmood Mamdani's *The Myth of Population Control* (1972), in which he argued that—contrary to the assumption of the Khanna Study staff—large families were not the cause of poverty, but the result of poverty. However, my paper is not centrally concerned with Mamdani's book, but with a list of names: those who visited the study area at Khanna between 1953 and 1960. These include the eugenicist-philanthropist Clarence Gamble; Minister of Health for India, Rajkumari Amrit Kaur; the US Ambassador to India, Chester Bowles; representatives of the Rockefeller Foundation, Ford Foundation, and Population Council, and a handful of faculty of the Harvard School of Public Health. I argue that Khanna is important to the history of population control because its string of visitors articulates the characters and agendas which converged upon the idea of population control in postcolonial India. Focusing on the concerns of a handful of these visitors, I will argue that the Khanna Study—like Indian population more generally—emerged at the intersection of Cold War politics, postcolonial nation-building and postwar eugenics.

Mytheli SREENIVAS | Ohio State University, United States

'On a war footing': IUDs, medical mediations, and women's labour in India

Scholars and activists have noted the militarized language used to promote population control in “developing” countries during the 1960s and 1970s. Much of this research demonstrates how women's bodies served as targets of a war on population growth, such that their health and well-being became “collateral damage” in the struggle to reduce growth rates. This paper investigates the militarized rhetoric surrounding IUD programs in India to tease out another strand of discourse: the regulation of women's productive and reproductive labor to render them useful soldiers (not just targets) in a war effort. Whereas American interventions in Indian population control seemed to focus on women as targets, Indian medical discourses bore the simultaneous burden of rendering women fit subjects of the postcolonial nation by re-purposing their reproductive and productive labors. In other words, their reproduction was regulated to make them suitable subjects/workers within successive 5-year plans for economic development. I hope in the paper to examine the tensions between these various forms of regulation: women as targets vs. women as laborers; productive labor vs. reproductive labor; women as Indian national subjects vs. women as “third world” populations. I believe medical discourses were central to these efforts, and will be the focus of my attention.

Commentary: John P DiMoia | National University of Singapore, Singapore

S052. The work of medical schools since the Second World War: the reconfiguration of knowledge, practice and pedagogy

Sat 27 July, 09:00–12:30 ▪ Uni Place 4.206

Symposium organisers:

Jennifer GUNN | University of Minnesota, United States

James HOPKINS | University of Manchester, United Kingdom

Symposium abstract

Our symposium focuses on post WWII medical education and how knowledge was disseminated to students to be deployed in the practice of their work. We focus on three areas that relate to the Congress theme:

- The impact of workforce demands, policy and the evolution of specialisms in shaping medical pedagogy.
- The geography of medical education and the way in which the local, urban, regional and rural shaped the type of knowledge delivered and the manner of its delivery.
- The politics of health systems and institutional relationships and how these shaped the dissemination of knowledge.

Our symposium has eight papers, in two sessions. It is built on a collaboration between two groups of historians, at the University of Manchester and the University of Minnesota, each of which has also studied other sites. The International Congress will provide an ideal way of linking with studies from a wider range of sites, sharing knowledge, developing comparison and establishing a research network. We envisage that contacts before 2013 will uncover a range potential commentators for our sessions.

At Manchester, a program of local historical analysis was established by John Pickstone, now working with James Hopkins on the post WWII history of the Manchester Medical School. In the same group, Stephanie Snow is studying the evolution of the urban teaching hospital using St Thomas' and Guy's (London). At the University of Minnesota, Dominique Tobbell examines the development of academic health centres; Jennifer Gunn researches rural practice in the USA, Canada and the UK and Peter Kernahan has focussed on surgical training. Ellen More, at UMass, works on the creation of community medicine departments.

We thus have a good range of sites to study how medical schools adjusted their work to changing demands and labour markets, and how curricula and outcomes were related to changes in the production and systematisation of medical knowledge, the organisation of health care delivery, fashions in pedagogy, and changing demographics of patients and students. In each paper, contribution to these shared general issues will be complemented by studies of particular specialisms, including surgery, and how 'general practice' became more or less a specialism across different countries

Medical education has been studied more intensely than most aspects of education for STM, but not for the recent past. The opportunities here are intellectual as well as pragmatic, for we will be analyzing across a period which has seen massive changes in the content of medicine, and in its political economy: not least, a shift from 'discipline led' practice, pedagogy and self image among medical leaders, to evidence based practice in commercial and quasi-commercial contexts. Since such shifts are not confined to medicine, they may be of interest to many historians of the knowledges at work in recent STM.

S052-A. The identity, space and organization of medical education

Sat 27 July, 09:00–10:30 ▪ Uni Place 4.206

Chair: John PICKSTONE | University of Manchester, United Kingdom

Dominique TOBBELL | University of Minnesota, United States

Educating physicians for rural practice: the politics of medical education and health policy in post-World War II USA

In the U.S., health professions education is rooted in the health care delivery system. State governments rely on state-supported academic health centers (AHCs) to respond to the health care needs of its residents. In exchange for state funding, state AHCs are required to produce enough of the "right type" of health care professionals willing to work in underserved regions of the state. Since the 1940s, concerns about catastrophic shortages of primary care physicians have dominated state and federal health policy. Medical leaders, educators, and policymakers have debated how best to increase the supply of primary care physicians and ensure their adequate distribution throughout the country, particularly in underserved rural and nonurban areas. By 1959, the Surgeon General's Consultant Group on Medical Education had predicted a shortfall of 40,000 physicians by 1975 and recommended the expansion of existing medical schools and the creation of new schools. In 1963, Congress passed the Health Professions Education Assistance Act, which provided matching federal funds for the building of new, and the expansion of existing, medical schools. This paper examines the efforts of three state institutions—the University of California, the University of Florida, and the University of Minnesota—to train greater numbers of primary care physicians willing to work in underserved areas of the state. In the 1940s, the University of California responded to legislators' calls for greater numbers of physicians serving southern California by establishing a new medical school in Los Angeles. In the early 1950s, the University of Florida, heeding the concerns of legislators that residents in central and northern Florida lacked adequate access to

physicians, established a new medical school in the central northern town of Gainesville. During the 1960s, the University of Minnesota doubled the size of its medical school and in 1972 established a new two-year medical school in Duluth, which would prioritize preparing medical students for careers in rural practice. In each case, the medical schools had to balance the demands of legislators with the professional needs of their faculty, the expectations of the local medical profession, and the needs of their students and patients. This paper reveals the ways in which these dynamics played out within different institutions and states, and assesses what the implications have been for the broader system of health care delivery in the U.S.

Jennifer GUNN | University of Minnesota, United States

Reforming rural medicine through medical education, 1945-1975: no solution to the redistribution of physicians

In the three decades immediately following World War II, American states struggled to solve its long-standing inequitable geographic distribution of medical resources and access to medical care. The 1946 Hospital Survey and Construction Act, better known as Hill-Burton, was intended to address the need for more hospitals in underserved areas, but by the early 1950s, some new rural hospitals were closing because of a lack of physicians to staff them. Even countries with provincial or national health care plans, such as Canada and the UK, faced difficulties getting physicians to locate in remote areas. As in earlier periods of reform, medical education was seen as the vehicle for changing practice, but now within the framework of a more comprehensive approach including a mix of financial incentives, regional planning, post-graduate medical education, and the revitalization of general practice. One of the best-known state plans, the Kansas Rural Health Plan, featured repeatedly in popular magazines at the time and became the model for a national plan endorsed by the National Farm Bureau in 1948. Its primary feature was an expansion of the state medical school, supplemented with encouragement to communities to subsidize appropriate "medical workshops" to attract physicians, and broadening continuing medical education to address rural general practitioners' potential intellectual isolation. Other states, such as Kentucky and North Carolina, and the Commonwealth Fund established loan programs for medical students who took up rural practice, while Michigan promoted increased Blue Cross insurance participation in rural areas to allay physicians' financial concerns. Some Canadian and US medical schools established rural student recruitment goals and voluntary and mandatory rural preceptorship programs, culminating in full-year rural clerkships in Minnesota and a consortium of western states by the early 1970s. However, the continuing shortage of medical personnel in rural areas contributed to national debates about medical workforce supply and the creation of new public medical schools with an emphasis on primary care in the US in the 1970s. A mix of constituencies with different motivations—health professional organizations, local communities, agricultural lobbies, government agencies, and medical education leaders—formulated a range of post-war approaches to providing doctors for underserved areas. All were voluntary and relatively ineffectual. The assumption of the necessity to preserve physician autonomy, and in the American context to fend off "socialized medicine," undermined alternative models for rural medical education and practice, even as medical leaders worried that the inability to resolve rural disparities posed a significant threat to the existing system of medical education and care.

Stephanie SNOW | University of Manchester, United Kingdom

The 'making' of medical students and the 'remaking' of medical schools: identity, culture and organisational change in London, 1960-2000s

Much attention has been paid to the processes through which students in medical schools acquire knowledge, skills and values and form professional identities that establish new ways of thinking and relating as

doctors. Yet there has been little exploration of the influence of the specific organisational culture of different medical schools with different histories, behaviours and practices. In London, the Todd Report (1968) marked the beginning of a process of successive mergers and a strengthening of ties with multi-faculty colleges to ensure medical students engaged with a broader academic setting and had close access to the sciences. This paper uses the merger between Guy's and St Thomas' which created the United Medical and Dental Schools (UMDS) in 1982, and the later merger between UMDS and King's College in 1998 to explore the nature of institutional identity in medical students and the ways in which it was made and remade over the period. Drawing on a wide range of sources from student memoirs to interviews with medical school staff and students, it analyses how a variety of social formal (teaching) and informal (sport) interactions between students and teaching staff created and embedded strong and emotional attachments to a particular medical school. Being a 'Tommy's' student was not the same as being a 'Guy's' student, particularly on the rugby pitch. It suggests that the early merger had less of an impact upon students because the pedagogic model and teaching structures remained the same; this enabled identity to be preserved through the allegiances to teaching hospitals. The later merger was a more complex organisational reconfiguration which produced a much larger intake of students who were then required to move between different clinical sites. This limited the opportunities to form strong attachments to specific sites. During the same period, the pedagogic model changed and other factors such as the European Working Time Directive forced new ways of working which meant that identity began to shift from specific institutions to student cohorts.

James HOPKINS | University of Manchester, United Kingdom

Changing places: the architecture and geography of medical education in Manchester

In 1973 the University of Manchester's Medical School moved from overcrowded Victorian premises into Europe's largest building for medical education and research. The Stopford building, named after the anatomist and University Vice-Chancellor, John Stopford, promised to significantly expand the educational accommodation and provide adaptable research spaces with the latest technology. Histories of medicine have explored the place of hospitals within cities and histories of medical education have examined the development of pedagogies mainly in national contexts. This paper uses the micro-geography of a small area of Manchester to explore how physical space has acted as an agent for, and as evidence of, change in medical education. It considers how the architects and their clients saw the medical pedagogy of their present, what they presupposed about the future of medicine, hospitals and the city, and how their design fared. The paper is based on archival research and oral history interviews with the architect, key decision makers and the building's users. The plan for the new Medical School was based on years of research in Europe and the USA by an architectural practice well known for its educational buildings. Their design was radically different to the previous Victorian gothic medical school: it was vastly bigger, requiring the demolition of eight city blocks, but allowed the School to triple its student numbers and provided generous space for research; it was physically imposing, but simple in design and used technology to ensure that the building was equipped for the latest research. However, education does not happen in isolation and their proposals had to negotiate with plans to radically change Manchester's transport infrastructure around and underneath the site, whilst ensuring close proximity to the region's main hospital. Despite innovative design features, forty years on the building is seen as aesthetically displeasing, unsuitable for current needs and costly to maintain. The architect tried to make the building flexible, to meet the ways in which medical education was expected to evolve, but so radical were changes in bioscience research and medical curricula that the building came to hinder the purposes for which it was designed. This paper explores prophetic attempts to provide a building for the future,

and uses the building's physical evidence to examine the interaction between space and medical education.

S052-B. Policy and specialisms in medical education

Sat 27 July, 11:00–12:30 • Uni Place 4.206

Chair: Stephanie SNOW | University of Manchester, United Kingdom

Charlotte BORST | Whittier College, United States

Choosing the student body for medical school: race, gender, and Cold War science

At the end of WW 2, American medical schools were anxious to return to a more normal admissions policy. The military's policy of choosing students solely on their science training and potential for a military career had elicited substantial disapproval among civilian medical educators, who sought substantial changes in the postwar period. As AAMC President Stanley Dorst, noted in 1954, academic medicine should remember that "the ultimate goal of all education is not technical competence, not accumulated knowledge, but the development of wisdom." Current trends in preparation for medicine threatened to "replac[e] a learned profession with a multitude of highly competitive, closely organized guilds."

The history of medical school admissions in the post-WW2 period probes assumptions about the nature of science and its ability to support political and social assumptions about the racialized and gendered profile of "the American character." Picking the "right" student body was crucial for American medical schools, as physicians were part of the scientific professional class, and the Cold War climate mandated that scientific professionals were expected to not only heal the sick and prevent disease, but also to provide an intellectual bulwark against the "Soviet threat." Naturally, these postwar studies employed the methodology of science—one based on "systematic theory," specifically psychology and "the newer social sciences," relying heavily on theories of personality. Merit should be determined scientifically, with the "mature personality" counting as much as intelligence.

This narrative for this paper shows that civilians, not the military, who drove wider-spread use of social science methodology among the civilian population in the 1950s. Between 1950 and 1970, the AAMC's new social science office used the tools of personality psychology to produce massive numbers of studies to assess the ideal candidate for medical school. Cold War beliefs in the efficacy of science research had a significant impact of how they parlayed their findings to establish admissions policies. The use of personality and other standardized tests created a scientific rationale for a profile that supported gendered and racialized profiles for medical school admissions that changed only decades later.

Julian M. SIMPSON | University of Manchester, United Kingdom

The socio-cognitive UK/South Asian medical community and the staffing of the NHS, circa 1948-1983

This paper highlights the importance of the influence of UK medical training and the continuing aura of British medical qualifications in the Indian subcontinent to the staffing of the UK's National Health Service (NHS) in the first thirty-five years of its existence. Its conclusions are based on thirty-seven interviews with South-Asian trained doctors who worked as GPs in the NHS and on archival research. If British rule in the Indian subcontinent came to an end in the 1940s, the pattern of 'medical dependency' (Jeffery, 1979) defined under the British Empire persisted post-independence. The education that South Asian doctors received was modeled on the curricula of UK medical schools. Lessons and

manuals were in English, teaching was frequently delivered by doctors who had themselves trained in the UK. Gaining a postgraduate qualification in the former metropole continued to be perceived as the ultimate accolade for young graduates aspiring to a successful medical career. Rather than seeing the migration of South Asian doctors to the UK exclusively as a response to staff shortages in an expanding NHS, it is helpful to place this movement in the context of the longer history of the movement of doctors within the British Empire. Recognising that there is a common 'socio-cognitive community' which links medicine in the Indian subcontinent and in the UK (Raghuram et al. 2011) serves to bring to the fore some of the historical factors which led to South Asian doctors being employed in the NHS. This, in turn, helps to explain how the NHS was able to meet its staffing requirements in the first thirty-five years of its existence. The overlap between medical training and the filling of junior hospital posts supported the emergence of an official UK discourse according to which doctors were in the country on a temporary basis to train, rather than to offer a permanent solution to staff shortages. Doctors themselves talk of coming to the UK to gain qualifications, rather than of planning to migrate permanently. The National Health Service in the first three and a half decades of its existence can thus be seen as a post-imperial institution, supported in its development and shaped in its nature by the persistence of patterns of thinking and teaching in South Asian medical schools and of movement of South Asian medical graduates which were defined at the time of the British Empire.

Peter KERNAHAN | University of Minnesota, United States

'Usurious dividends to all participants': national policy, local politics, and the evolution of the surgical residency in Minnesota, 1936-1966

William Halsted is generally credited with having established the first "true" surgical residency in the United States, based on German models, at Johns Hopkins Hospital beginning in the 1880s. By 1940, only about ten such residencies existed in the United States. While undeniably successful in producing an academic elite, these programs had little immediate influence at the community level. In 1915, the Mayo Clinic and the University of Minnesota formalized a competing, "graduate school model" of surgical education. Nonetheless, much surgical training remained on an ad hoc basis, a source of growing concern to surgical leaders by the 1930s. The existence of three competing but overlapping national organizations compounded the problem of reforming surgical education. The American College of Surgeons, founded in 1913 and modeled on the Royal College of Surgeons of England, had initially focused its efforts on certifying and improving the qualifications of surgeons already in practice. The American Board of Surgery (1937) was the product of a younger generation of academic leaders dissatisfied with the College's certification standards. At the same time the American Medical Association continued to approve hospitals for internships and residencies. Minnesota provides an interesting case study of how demands for well-trained surgeons and surgical training were negotiated at the local level. During the study period, essentially all possible models of graduate surgical education existed within the same state. Private preceptorship, a large private clinic fellowship, a university-based academic program, public hospital programs, and, in response to the demand for surgical education following the war, community hospital-based programs all existed in an uneasy relationship. Tension between the University and the community hospitals arose over the conflicting agendas of full-time directors and hospitals oriented to private, paying patients and their private practice physicians. The insistence of University leaders on original laboratory research as a defining characteristic of the true surgical residency caused particular conflict. Consequently, affiliations with community hospitals would be organized and dropped throughout this period. Superimposed upon this local turmoil were demands made by the national organizations supervising residency training. This paper will examine these tensions as part of the larger national story and demonstrate the contingent nature of surgical education during this period.

Ellen MORE | University of Massachusetts Medical School, United States

Oral history, institutional memory, and the meaning of primary care: family medicine versus community medicine in the history of academic medicine

This paper explores a lesser known facet of the campaign to define and integrate primary care within the curricula of research-oriented medical schools in the United States. Among veterans of United States medical schools founded during the 1960s, especially public medical schools, it is a commonplace to claim that they owed their existence to the widespread fear of a physician shortage. Moreover, given the successful campaign to transmute "general practice" into "Family Medicine" during that same decade, such a claim often conflates the two trends: this cohort of medical schools, it is said, gave a crucial boost to the rise of primary care. At the University of Massachusetts Medical School, founded in 1962, for example, hallowed institutional lore decrees that the school was created to produce more primary care physicians, especially in the specialty of "Family Medicine." Oral histories, in concert with institutional records and personal papers, point to a more complicated story. The rise of "primary care" was hardly uncontested, even at a publicly-funded school championed by a Democratic legislature and by organized labor. Indeed until the mid-1970s, it was difficult even to define the concept. The obstacles faced by Family practitioners at the University of Massachusetts arose not only from the "usual suspects" in Internal Medicine and Obstetrics-Gynecology. The new specialty's gravest battles were fought, in a classic example of professional boundary disputes, against its ostensible friend and, arguably, close relative, the field of Community Medicine. Community Medicine's investment in "Community-Oriented Primary Care" positioned it to directly compete with Family Medicine for resources and for residency recruits. The outcome at UMass Medical School, where Family Medicine eventually became the senior partner in a combined department of Family Medicine and Community Health, points to the benefit of using institutional history to identify underappreciated aspects of broader issues, in this case, competing approaches to primary care education and health care delivery, as well as the challenge of integrating primary care into research-oriented medical schools.

S053. Knowledge at work across cultural boundaries

Sponsoring body:

IASCUD: International Association for Science and Cultural Diversity

Tue 23 July, 09:10–12:40 ▪ Roscoe 2.3

Symposium organisers:

Irfan HABIB | National University of Educational Planning and Administration, India

Kenji ITO | Sokendai, Japan

Symposium abstract

History of science and history of technology, as fields of research, are affected by several trends that require critical reflection. Most of these trends are widespread. The issue of cultural diversity is quite widespread and diversity is conceived around national, ethnic, linguistic and religious identities. These identities are perceived as homogenous and essentially distinct from each other. Some of the researches in history of science and technology also begin with similar assumptions, and at times these researches contribute to the shaping of such identities.

“Area studies” still constitute a way of organizing research in social sciences and humanities. According to such a pattern for the organization of research, the history of science in China would be more closely related to the study of ancient bronzes or to political changes since Deng Xiaoping than it would relate to the history of knowledge in India. Conducting research in this way contributes, in our view, more to reifying identities than it allows tackling the theoretical problems raised by the emergence, development and use of knowledge in various social contexts.

This last remark leads us to another set of unfortunate trends that affect history of science and history of technology and that are more specific to these fields. The organization of research described above has tangible effects. The disciplines of history of science and history of technology mainly cover science and technology in the West, whereas all the other parts of the planet are either dealt with “area studies” or approached through specific research programs such as “science and empires”, “science and technology in the European periphery.”

There is no doubt that these research programs are essential for developing our knowledge in history of science and technology worldwide. However, they clearly reflect the fact that the fields of history of science and history of technology show the global picture of an asymmetric approach to phenomena related to knowledge, depending on where these phenomena occurred. Accordingly, the history of knowledge develops in groups that hardly communicate to each other or, to say the least, fail to establish firm bridges and syntheses among their contributions.

In an effort to promote critical analyses of such trends in the field of the history of knowledge, and in responding to the general theme of the 24th Congress, “Knowledge at Work,” International Association for Science and Cultural Diversity (IASCUD) proposes a symposium on production, transfer, and use of knowledge that defy cultural boundaries. It calls for papers that seek a theoretical framework to approach science and technology not confined within national, regional, or cultural boundaries, or papers that critically examines what counts or does not counts as a single cultural collective in which production and use of knowledge can be meaningfully described.

S053-A

Tue 23 July, 09:10–10:40 • Roscoe 2.3

Chair: Kenji ITO | Sokendai, Japan

Irfan HABIB | National University of Educational Planning and Administration, India

Early Islamic eclecticism and the pursuit of scientific knowledge

Was Islam as rigid and narrow as it appears today? Was it really open to the influence of other cultures and intellectual traditions, particularly outside Islam? Was the pursuit of knowledge, science in particular, merely limited to Quran and hadith for its sources? I raise these questions in the context of scholarship, which is attempting to articulate for “Islamic science” as a binary to modern science. I do this by reflecting on the early Islamic eclecticism where scientific enterprise was a collective project, involving Nestorian Christians, Buddhists, Hindus and others, under the inspired leadership of Muslim caliphs and intellectual leaders. There is an ongoing essentialization of science within a section of scholarship in history of science, which need to be discussed and debated

Robert MIDDEKE-CONLIN | Université Paris Diderot - Paris 7, France

Connecting a disconnect: applying scribal education to a professional setting during the old Babylonian period

How economic and administrative data, presented in the numerous tablets throughout Mesopotamia, related to the actual mechanisms presented in the mathematical corpus is poorly understood. Indeed, few modern scholars have attempted to cross the divide between studies of the myriad published documents dealing with the economic and administrative apparatuses of the ancient Mesopotamian cities on the one hand, and the mathematical texts produced and used within the school environment on the other. This shortfall is methodological: few adequate tools have been produced to detect this connection. This presentation is the beginnings of an effort to bridge the gap, so to speak. It will attempt to compare administrative and economic procedures presented in the mathematical materials and used in the scribal curriculum to the mechanisms found in a real economic/administrative document of the Old Babylonian period, YBC 7473. This document has been understood as a balanced silver account representing four years of activity, starting around 1823 BCE. The account is divided into two primary sections, a section dealing with capital, and a second dealing with expenditures. In the capital section we see conversions of in kind products into silver equivalents, as well as the exchange rate. By looking at these rates, we can see the mathematical education at work in the professional setting. To develop this study, three types of mathematical texts will be examined: extracts from a series text, practice tablets with conversion tables written on them, and tables of approximations. In the end we will see that YBC 7473 was not simply a copy of already known data, but that this text represented the conversion itself using tools that were taught in the course of the scribe’s education. To put it concisely, we will see how mathematical knowledge crossed the boundary of a school culture to a specific professional culture.

Karine CHEMLA | European Research Council, CNRS & Université Paris Diderot - Paris 7, France

The diversity of mathematical cultures in ancient China

Mathematical manuscripts recently excavated from tombs sealed in China around the beginning of the unification of the Empire (end of the 3rd century BCE) provide new evidence about mathematical activity in early imperial China. In fact, and more precisely, they provide evidence of a new type, when compared to writings handed down through the written tradition. The thesis for which this paper aims to argue, with respect to the history of mathematics in ancient China, is that these sources allow us to perceive a diversity of mathematical cultures in early imperial China. These writings mainly, if not only, deal with mathematical problems and procedures solving them—in contemporary words, “algorithms.” This feature, as well as others, indicates that these cultures had much in common, and were thus by no means impervious to each other. However, they also show key differences. It is by focusing on how they document “knowledge at work” that these differences can be brought to light. This is the second issue, this one related to historiography, for which I shall argue in the presentation. The source material and topic dealt with will require that I discuss what I mean by a “mathematical culture” and that I consider the question of which aspects of a given culture can be documented by these sources.

Agathe KELLER | Université Paris Diderot - Paris 7, France

How we write the history of numerical transmissions: a journey from Alexander von Humboldt to Hankel, via Woepcke on the origins of the Indian decimal place-value notation, mathematics, and language

During the XIXth and early XXth century a debate on the origins of the decimal place value notation crossed different millieus and frontiers, sparking philological studies, editions of mathematical texts and serving as a backdrop to narrations on the world history of mathematics. In between 1819 and 1829 the naturalist Alexander von Humboldt (1769–1859) wrote and published two texts on the history of numbers that were subsequently translated and studied by the historian of arabic

mathematics, Franz Woepcke (1826-1864), who further discussed them in his 1863, *Mémoire sur la propagation des chiffres indiens*. Woepcke's study was then used in the mathematician's Hermann Hankel's (1839-1873) posthumous *Gezchichte der Mathematik in Alterthum und Mittelalter*.

Alexander von Humboldt's history of mathematics is singular in many points, two will hold our attention here: First, he closely links thoughts of numbers to thoughts on language. Second he pleads for the use of algebra when explaining ancient mathematical thought, as a way of underlying the universal rationality of man's mind. This paper, after exposing Humboldt's theories will further look at its posterity in Woepcke and Hankel's works. The more general aim of such a study being to highlight how homogenized points of view on nations, languages, religions, numbers or algebra shaped what came to be at the end of the nineteenth century a standard discourse on the history of numerical transmissions.

S053-B

Tue 23 July, 11:10–12:40 ▪ Roscoe 2.3

Chair: Irfan HABIB | National University of Educational Planning and Administration, India

André Felipe CÂNDIDO DA SILVA | Universidade de São Paulo, Brazil

Magali ROMERO SÁ | Oswaldo Cruz Foundation, Brazil

Transnational intellectual networks between Brazil and Nazi Germany (1933-1942)

The aim of the present communication is to address the exchanges of scientists and students between Brazil and Nazi Germany from 1933 to 1942, when Brazil entered World War II on Allied side. The scientific relations between Brazil and Germany in those years were associated, on the one hand, by the interests and strategies of the cultural diplomacy from Berlin. On the other hand, the individuals involved in this exchange tried to make possible the efforts to intellectual cooperation and institutional projects. One field of these relations was the appointment of German professors to the Brazilian universities, in the moment when these were emerging as the principal centres of training and scientific research. In such case, the tensions brought by the Nazi policy of exclusion of Jews academics reflected in the microcosms of the Brazilian scientific community. The scientific expeditions directed to Brazil constituted a much dynamic aspect of the Brazilian-German exchanges. Their objectives were to make researches in fields such as genetic and racial hygiene, natural history, geography and ethnography. Here is to mention the expeditions of Ernst Nauck and Gustav Giemsa (1936), Hans Krieg (1937-1938), Otto Schulz-Kampfenkel (1935-1938) and Adolf Schneider with Helmut Sick (1939-1942). This paper intends to explore the goals, interests and tensions that followed these undertakings, the scientists and institutions who supported them in both sides of Atlantic, as well as the impacts they had in scientific agendas, mutual knowledge, and in the political bilateral relationships, marked by intense commercial exchanges and affinities between authoritarian regimes in the two countries.

Takashi NISHIYAMA | State University of New York, Brockport, United States

Suicidal or suicide operation? Cross-cultural studies of wartime military operation/engineering in Asia and the west, 1940-55

This work will explore the cultural implications of military operation and technology from 1940 to 1955. Previous studies of wartime cultures have shown that the conduct of war was at least in part predicated on the idea that the enemy should be de-humanized. The binary thinking of wartime--"the Other" versus the self-righteous "Us"--dominates cultural studies of interstate war in peacetime. To test the validity and vitality of this dichotomous thinking, I will employ historical, comparative, and

international perspectives, focusing on Japan, the United States, and other nations that developed unconventional and controversial military missions for homeland defense, commonly (and often wrongly) referred to as *kamikaze*. In the midst of war, each country developed/deployed airplanes specifically designed to crash into incoming enemy targets, an action that left the operators little or no chance of survival. Many still believe that only wartime Japan has executed this special attack operation in actual battle, thus perpetuating misconceptions attached to the word *kamikaze* since the end of World War II in 1945. Detached from stereotypes, my study will ask: How did different countries, including Japan, try to render their own airmen for homeland defense? How did engineers, scientists, and military strategists in each country define "necessary evil" and solve inherently complex issues at times of war? How and why did the knowledge of suicide/suicidal missions move across national borders, and to what end? My paper will highlight the similarities and differences in how different nations constructed their cultures of war for suicide/suicidal military operations during World War II and the Cold War.

Kenji ITO | Sokendai, Japan

Science "made in Japan"?: cultural diversity and transnationality in post-World War II Japanese nuclear physics

In the preface of the English version of the official report by the Fukushima Nuclear Accident Independent Investigation Commission of the National Diet of Japan, the commission chair Kurokawa Kiyoshi writes that the nuclear accident in Fukushima "was a disaster 'Made in Japan'." According to him, "Its fundamental causes are to be found in the ingrained conventions of Japanese culture" (NAIIC 2012). Curiously, such a culturalist explanation of the disaster only appears in the English version of the report, and the Japanese version gives significantly more fine-grained analysis of institutional cultures of the relevant organizations. Such "self-Orientalism" appears even in depiction of science, as was the case with Yukawa Hideki's self-fashioning as an Oriental physicist (Yukawa 1973). Criticizing such historiography that essentializes Japanese national culture, this paper studies nuclear physics in post-WWII Japan up to the mid-1950s and discusses how Japan's national identities in relation to nuclear power and nuclear states were invented and shaped. To achieve this, the paper will do two things. First, it will explore transnational aspects of nuclear physics in Japan. Recent historiography of nuclear power stresses transnational aspects, as exemplified by Abraham(2006) and Hecht(2012). In Japan, too, relations to other countries, in particular other nuclear States, the United States among others, played a crucial role in the introduction of nuclear power into Japan. By examining this early history, the paper will show that both nuclear physics and nuclear engineering in Japan of this period was hardly "made in Japan"; rather, it was a result of political and cultural negotiations across various boundaries. Second, it will show cultural diversity within nuclear physics in Japan of this period. Having suffered twice from the American nuclear weapons in the recent past, Japan in the 1950s had problematic relations to the United States and nuclear power. To attain "nuclearity"(Hecht), post-WWII Japan had to mobilize actors with diverse cultural backgrounds and invoke various cultural representations. Scientists, engineers, politicians, and industrialists were involved, each displaying cultural diversity among themselves. Through such considerations, this paper will conclude that it is wrong to assume essential cultural uniqueness of Japan's nuclear physics; Japan's nuclear physics shared many aspects with other countries, both strengths and problems.

S054. Alchemy: the relationship between working and knowing

from late antiquity to the seventeenth century

Sat 27 July, 14:10–15:40 • Uni Place 4.214

Symposium organisers:

Rémi FRANCKOWIAK | Université Lille 1: Sciences et Technologies, France

Gianna KATSIAMPOURA | National Hellenic Research Foundation, Greece

Symposium abstract

Alchemy was craft and science. Alchemy emerged from the combination of craftsmen's practice and a discourse; a discourse supposed to account for the transformations of matter carried out by craftsman's hands within the bounds of a work based on a simple imitation of nature, or depending on the case a discourse exposing real productions - true or supposed - equal to those of nature.

The alchemist was the secretary and the operator of nature. His work was grounded on a perfect mastery of crafts (metallurgy, pharmacy, dye-works, etc.), of a long and detailed observation of nature at work and a more or less speculative - solid knowledge concerning the secrets of nature. His knowledge was always a know-how. The justification of his work was based on its social utility (assistance to a course of treatment, participation in various economy sectors development). The manifestation of his knowledge made a strong impression: it was or was concerned to be always concrete, from cosmetic production to metal transmutation via the demonstration of the true principles of bodies. The image of the alchemist combined the scholar's and the craftsman's one. The place where the images met each other was the laboratory.

In this context, we will examine in the symposium the relation between alchemy and technical knowledge as well as the relation between alchemical productions/alchemical technical assistance and society and political power.

Chairs:

Rémi FRANCKOWIAK | Université Lille 1: Sciences et Technologies, France

Gianna KATSIAMPOURA | National Hellenic Research Foundation, Greece

Hariclia BRECOULAKI | National Hellenic Research Foundation, Greece

Murex Purple and the enduring potency of a symbolic colour: transmutative, magical and apotropaic virtues

Murex or Tyrian Purple, the most precious colour-fast dye in antiquity—mostly known for the dyeing of textiles with its bright blood-red and violet hues—, served as a symbol of royalty, high prestige and “glorious death” from as far back as the Late Bronze Age. The recognition of purple as a signifier of wealth persisted for centuries, and was employed by Persians, Greeks and Romans as a means of establishing status, of distinguishing kings and emperors, as well as their courts and high officials, both in life and in death (burial shrouds). The use of purple as a codifier of social hierarchy came to a close with the fall of the Byzantine Empire and was substituted thereafter by the red dye produced from the plant *Rubria Tinctorum*. However, since antiquity, fascination with the colour purple was intimately linked with the craftsmanship and knowledge required for its manufacture, and with the fact that alchemist experimentations encompassed techniques developed by dyers; dyers, who actually attempted to counterfeit the rare and valuable Tyrian purple dye, as has been made evident through the numerous receipts from the *Papyri Holmensis* and *Leidensis*. Purple was said to be endowed with

“miraculous” properties, due to the transformation process that occurred during its elaboration phases, described in great detail by ancient authors. More specifically, once the gland is exposed to air, solar irradiation and oxidation lead to the production of several colours that are produced at various stages, colours which include yellow, blue, green, red and violet. The miracle of purple was, therefore, the fact that it appeared to incorporate both darkness and light and, hence, the whole world of colour. The secrets of the science of transformation and the quest for « immortality » were therefore inherent to the very process of producing the purple dye. Archaeological testimonials, such as wall-paintings and precious polychrome objects where purple was used as a pigment, also allow us to broaden our horizons, by means of the elucidation of potential symbolic meanings of the colour purple in antiquity, meanings related mainly to its apotropaic virtues. Finally, information from the Magical Papyri on the use of purple cloth and skin in magical rituals, allow us to further speculate on the possible « mystical » components of purple and its metaphorical connections with the soul.

Vangelis KOUTALIS | National Hellenic Research Foundation, Greece

Knowledge and labour in the alchemical lectures of Stephanus of Alexandria.

Historical research on Renaissance alchemy (or ‘chymistry’) has brought to light plenty of evidence for the crucial role that theosophy, and more generally theological or Christological speculations, played in the rhetorical strategies deployed by early modern chymists in order to justify their claim to be treated as genuine philosophers, or at least practitioners of a ‘liberal art’, equally legitimate as the traditional parts of the liberal arts curriculum, and perhaps even more epistemically valuable itself than it could be proved of the latter. Alchemy was re-defined as an art reminiscent of the art of cosmopoiesis, that is to say, the art by means of which God created, and still always re-creates the universe.

Of particular importance, in this respect, is also the fact that the new conception of the relation between nature and God, developed especially in the works of Paracelsus and his disciples, necessitated a re-evaluation of labour, which from then on was associated with the human potential both for creativity and for acquiring objective knowledge through creativity.

Going back to the alchemical praxeis of Stephanus of Alexandria (7th century), who was the pioneer and by far the most influential representative of the Byzantine alchemical commentary tradition, we will examine how labour is signified, and how the relation between God and nature is defined, so as to ascertain resemblances and differences with the early modern chymical theories. Stephanus, indeed, draws an analogy between the creativity of human labour and the ability of the soul to determine itself, transcending the limits of the body, and imitating God, the creator-artist of the cosmos. Thus he may be seen to foreshadow early modern theories on the Anima Mundi and on “natural magic”, that were extensively utilized by chymists. He does not, however, develop, neither does he attempt to trace out, a conceptual constellation alternative to that of the Aristotelian natural philosophy, or distinct and divergent from that of the Neoplatonic metaphysics, which could enable him to link experimental labour with objective knowledge, the experience of doing something with the process of knowing what something really is.

Gianna KATSIAMPOURA | National Hellenic Research Foundation, Greece

Michael Psellus: a discussion about the substance of matter and alchemy's techniques in eleventh-century Byzantium

Michael Psellus, Director of the Imperial School of Higher Education in Constantinople, was one of the most famous scholars of 11th century Byzantium. His work is extended in various fields, from Theology and

History to Natural Philosophy and Alchemy. This paper examines his work on gold making in comparison with his ideas about the transmutation of Matter, i.e. his work "On gold making" (Περὶ χρυσοποιίας) and his "Omnifaria Doctrina" (Διδασκαλία παντοδαπῆ). Psellus in "Omnifaria Doctrina", a work on Natural Philosophy, presents his philosophical ideas about Nature and Matter. Among others, he tries to explain Nature and its changes using the principles of Nature Philosophy. In this context, he proposes methods and techniques for the transmutation of Matter. The interesting point here is that although Michael Psellus has an ancient Greek philosophical background (mainly Aristotelian), according to which Natural Philosophy is actually distinct from techniques and technology, he nevertheless investigates and proposes techniques for the transmutation of Matter. So, he legitimates the alchemical practice and consequently Alchemy within the epistemological context of the accepted Natural Philosophy of the period.

Hsiao-Yun Sherry CHENG | National Tsing Hua University, Taiwan

The Chinese 'Diagram of the Supreme Ultimate' (Tai ji tu) in an Islamic alchemical treatise: a re-examination

My paper focuses on a group of alchemical images found in Western and Chinese alchemy and featuring one or more agents forming a circle. The Chinese diagram known as "Diagram of the Supreme Ultimate" (taijitu 太極圖) represents two cosmic forces, Yin and Yang, completing each other; Western alchemical texts contain circular symbols of the same type such as the dragon biting its own tail, or two birds chasing each other, and so on. Even though these Chinese and Western diagram contain apparent similarities, it remains unknown whether there were any connections between them. Some authors claimed that such connections existed; for example, Persis Berlekamp in his paper of 2003 discussed a painting titled "The Silvery Water" found in an Islamic alchemical manuscript of 1339, and claimed that the symbol of two birds chasing each other and forming a circle originated from the Chinese diagram of Supreme Ultimate. In my paper, I would like to discuss the traditions of this kind of alchemical symbols; more specifically, I will focus on the following issues: (1) the "Diagram of the Supreme Ultimate" is found in Chinese treatises of the Song Dynasty (960-1279), but when did it appear for the first time, and where it originated from? (2) Were any other diagrams similar to the "Diagram of the Supreme Ultimate" and/or to the diagram of two birds found in Islamic and European alchemical treatises? (3) More broadly, what was the tradition of "circular diagrams" in Islamic and Western traditions? (4) Does a similarity of two diagrams always justifies that a transmission of diagrams and underlying concepts took place?

To deal with these questions, I will discuss the origin of the "Diagram of the Supreme Ultimate" and its meaning in Chinese alchemy. After that, I will focus on the symbol of dragon in traditional European alchemy. In particular, I will discuss Zhou Dunyi's 周敦頤 (1017-1073) Taiji tushuo 太極圖說 (Explanations of the Diagram of the Supreme Ultimate) and Wei Boyang's 魏伯陽 (fl. 142) Zhouyi Cantong qi 周易參同契 (The Kinship of the Three, in Accordance with the Book of Changes) concepts of the "Supreme Ultimate", and analyze the alchemical images found in European alchemical compendia such as the Philosophia Reformata (1622), De Lapide Philosophico (1625) and Collectanea Chymica (1693).

Sébastien MOUREAU | F.R.S./FNRS - Université catholique de Louvain, Belgium

Mercur et Hg: rapport entre les propriétés physiques et chimiques du mercure et les théories du mercure dans l'alchimie arabe et l'alchimie arabo-latine

Depuis les premiers textes alchimiques, le mercure occupe une place de choix parmi les substances qui intéressent les artisans alchimistes.

Toutefois, c'est avec l'apparition de la théorie du soufre et du mercure que ce métal devient un des pivots centraux de l'alchimie: il est alors considéré comme un des deux composants de tous les métaux, voire même comme le composant principal des métaux (le soufre jouant souvent un rôle secondaire). Différents leitmotivs le concernant apparaissent alors dans les textes, en particulier la nécessité presque obsessionnelle de le durcir (ou coaguler), et sa capacité à se sublimer. Mais toutes les affirmations théoriques sur le mercure ne sont pas arbitraires et fantasmagoriques, elles reposent le plus souvent sur des caractéristiques physiques et chimiques; cependant, les alchimistes prennent aussi souvent quelques libertés avec ces principes, et inventent parfois de toutes pièces des réactions. Je propose d'étudier les principales théories sur le mercure dans plusieurs grands textes alchimiques médiévaux arabes et dans quelques traductions latines de textes alchimiques arabes, et de montrer en quoi elles se basent sur des propriétés physiques et chimiques du mercure et en quoi elles s'en écartent, afin de mettre en lumière le va-et-vient entre la technique et la théorie.

Mercury and Hg: links between the physical and chemical properties of mercury and the theories of mercury in the Arabic alchemy and Arab-Latin alchemy

Since the first alchemical texts, mercury is one of the fundamental materials which interests alchemists. However, it is the development of the mercury and sulphur theory which makes this metal a principle in alchemy: it becomes one of the two components of metals, being even often the main component (sulphur is often secondary in some texts). Therefore, several topoi about mercury appears, especially the necessity to harden (or coagulate) it, and its ability to sublime. But most of the assertions about mercury are not arbitrary and odd, they are usually founded on physical and chemical properties of mercury; on the other side, alchemists also often slightly modify the truth of these principles, and sometimes forge false reactions. I propose to investigate the main theories about mercury in some important alchemical Arabic texts and Latin translations of Arabic treatises, and to show to which extent they are based on physical and chemical properties of mercury, and to which extent they are forged, in order to underline comings and goings from technique to theory.

Rémi FRANCKOWIAK | Université Lille 1: Sciences et Technologies, France

Alchemists at the service of economic development of France in the eighteenth century

The history of chemistry generally seems to admit that a distinction took place between alchemy and chemistry at the turn of the 18th century and then highlights especially chemists who advanced theoretical chemistry: E.-F. Geoffroy, Rouelle or Venel. However, beside these great names, there were other chemists not all really unknown but often recognized as less important. They were inter alia Hellot, Claude-Joseph Geoffroy, Grosse, Lebrecht, Du Fay. They shared all an obvious interest in alchemical works on the metal transmutation, an interest certainly visible in their papers and manuscripts but also sometimes in their published texts. And yet, all these chemists took part, in a privileged manner, in the economic development effort of France initiated in particular by the Regent, Philippe II Duke of Orleans. The latter, very interested in alchemy, placed directly under his protection, by 1715, the Royal Academy of Science which he wanted to make an essential instrument of his projects of reform and re-establishment of the kingdom, especially through the inquiry that he launched from 1716 to 1718 in order to create a national economy instead of the local economies. So the Duke of Orleans appears as a key character of the evolution of the 18th century chemistry: he named academicians people of his entourage related to

alchemy, who in their turn proposed candidates at the Academy when a place in the class of chemistry was released. The result was the constitution of a core of alchemical chemists in the Academy who all conformed to the requirement of utility and subordination to the interests of investors looking for scientific and technical competences provided by an Academy of Science more and more on the decline. The most representative character was Jean Hellot, practising alchemist and collector of alchemical texts but also academician, general inspector of the dyeing industry, chief assayer, organizer of the porcelain production, expert and advisor of several ministers on questions of crafts and trades, who was certainly selected at the commission for the mines, partly for his alchemical competences, as he was able to distinguish between charlatans and true scholars.

S055. Putting knowledge to war: research, development and the image of science in the First World War

Sponsoring body:

Notes and Records

Thu 25 July, 09:00–12:30 ▪ Uni Place 4.204

Symposium organisers:

Don LEGGETT | University of Kent, United Kingdom

Roy MACLEOD | University of Sydney, Australia

Symposium abstract

Many histories of science, technology and medicine in the First World War begin by identifying that the coming of conflict in 1914 provided a stimulus - for the organisation and, importantly, funding - of scientific, engineering and medical research and development. This picture of the relationship between war and science provides an inadequate basis for understanding an important moment in the institutionalisation and expansion of the enterprise of science. Relatively little attention has been paid to the images of science offered by scientists to institutions - governments, armed forces, industry, etc. - or the images of science as perceived by those institutions. Examining the various images of science in circulation between 1914 and 1918 provides an alternative basis for understanding how and why scientific knowledge was put to war - from which new responses to the familiar questions asked of this topic can be generated.

This symposium aims to bring fresh consideration to the history of STM and the First World War. By focusing on the institutions of wartime research and development, and the images of science generated within them, we aim to consider the following.

- The use and adaptation of scientific knowledge for national war efforts.
- How war concerns shaped sites of scientific work, including laboratories, universities and learned societies.
- The proliferation of research and development institutions.
- Models and cultures of research and development devised (and revised) during wartime.
- Locally contingent definitions of pure and applied science, and how actors sought to legitimate them.
- The transformation of the image of the scientist and the boundaries of scientific expertise.
- Science and propaganda.
- The social history of the wartime scientific workforce.

Through a series of case studies we aim to provide a richer picture of STM during the First World War. While we do not explicitly pursue a comparative historical approach, we hope that symposium discussion will further define the experiences of different STM disciplines in a number of combatant countries.

S055-A

Thu 25 July, 09:00–10:30 ▪ Uni Place 4.204

Chair: Don LEGGETT | University of Kent, United Kingdom

Roy MACLEOD | University of Sydney, Australia

Wartime chemistry, industrial innovation, and the 'devil's porridge': cordite and its context, 1915-1918

Following the 'shell crisis' of early 1915, and fearing prolonged dependence upon American sources of explosives, Britain's newly created Ministry of Munitions decided to build on a green field site at Gretna, near the Solway estuary, straddling the Scottish border with England, that would by 1916 become the largest explosives factory in the British Empire. Stretching 12 miles, and covering 30 square kilometres, this was to be for at least two years, possibly the largest green-field site factory complex in the world. The plant produced cordite, a propellant mixture of nitroglycerin and guncotton best described, in a phrase attributed to Sir Arthur Conan Doyle, as 'devil's porridge'. Built in record time, at a cost of over £9 millions, and eventually employing over 30,000 workers, Gretna became a symbol of Britain's approach to industrial warfare, and of its determination to achieve 'chemical independence' from Germany, and also from its allies. Thanks to contemporary visits of Rebecca West and others, the factory's role in the struggles of the 'Munitionettes' – and the history of wartime feminism – is secure. Everything about its size, construction, and productivity was of gargantuan proportions. Recalled today as the government's 'first sponsored new town in Britain', Gretna's output exceeded that of all the other British propellant plants combined. But that was to be only part of the story. At the time, far less was said, and far less made public, about Gretna's contribution to research and development, to its use of expert management, methods of manpower organisation, and innovation in plant design. Recalling an 'Oak Ridge' of a later war, with a safety record that many factories would envy, Gretna's success held important messages for the future – not least to American observers, who took its lessons home in 1918. This paper will outline some of these characteristics and achievements, and will suggest how those who designed and worked at Gretna succeeded in putting 'knowledge to war'.

Jeffrey JOHNSON | Villanova University, United States

Artillery propellants and picric acid: mobilizing chemistry in two German explosives plants

To facilitate examining and comparing how chemical knowledge was "put to war" in explosives plants on opposing sides of the Western Front, this paper will treat two German cases. In large part chosen because of the availability of sources, these are a relatively small state propellants plant, Saxony's Gnaschwitz State Powder Factory, and a high-explosives plant from the dye industry, Bayer's picric-acid plant in Dormagen. Gnaschwitz exemplifies the dramatic expansion of propellants production in the aftermath of unexpected munitions shortages following the initial mobilization in 1914; Dormagen exemplifies German efforts to double explosives production as part of the Hindenburg Program or "second mobilization" under the impact of the "battle of materials" inaugurated by the British Somme campaign in 1916. Each type of production plant (propellants vs. high explosives, state vs. private, single- vs. dual-use) presented inherent challenges to efforts to maximize efficiency and output. Their locations also necessitated trade-offs (security vs. access to resources). Further complications arose from severe shortages of critical raw materials, requiring a search for substitutes or alternate paths to production, as well

as the recovery and re-use of reagents and solvents. Works chemists and plant laboratories thus played important roles in providing innovative solutions to many of these problems. At the same time, shortages of German male workers, skilled and unskilled, presented additional security and management problems resulting from the use of prisoners, foreign workers, and women. By 1918 the inherent limitations and inefficiencies of the German system required trade-offs that sacrificed quality for greater quantity, ultimately contributing to the eventual German defeat. In the aftermath, the “chemical disarmament” provisions of the Versailles Treaty led to the forced dismantling of these plants, accompanied by mandated technology transfers to the Allies. Thus both sides learned lessons, albeit not the same ones, from the German experience.

Peter REED | Independent Researcher, United Kingdom

Rising to the challenge: the United Alkali Company's central laboratory during World War I

In 1890 forty-seven Leblanc industry companies in Britain producing alkali, sulphuric acid and bleaching powder, what was known collectively as the heavy chemical industry because of their bulk production, amalgamated to form the United Alkali Company and become the largest chemical company in the world. At the company's first board meeting in December 1890 the directors agreed to establish a Central Laboratory, probably one of the first industrial research laboratories in Britain, and create the post of head of laboratory. With the existing company laboratories proving unsuitable, a new laboratory was built in Widnes and was completed in 1892. The first head of laboratory was Ferdinand Hurter who had worked in Widnes for many years after training in Zurich and with Bunsen in Heidelberg, and was a much respected industrial chemist. The objective for the new laboratory was to search out new processes and products to replace the obsolete Leblanc process. As with dye manufacturers, scrutiny of patents was seen as key to future opportunities. While some progress was made before WW1, it was probably during the war that the Central Laboratory achieved its greatest success. Government contracts required rapid development of new processes, marked growth in production of many existing chemicals and the adaptation of existing plant for the production of new chemicals. The WW1 period showed UAC and its Central Laboratory at their innovative best. For their leadership, Max Muspratt (chairman) was awarded a baronetcy and George Clayton (director) was awarded a CBE. The paper will review how UAC adapted to the demands of war: developing chemical plant to produce oleum via three variants of the contact process since sulphuric acid produced by the lead chamber process was not sufficiently concentrated for producing explosives; fabricating chemical plant for the production of six poison gases; and devising new reaction pathways and chemical plant for picric acid (an explosive) and ammonium perchlorate (for fuses and detonators).

Heather PERRY | University of North Carolina at Charlotte, United States

Feeding war: nutrition, health and the mobilized kitchen in WWI Germany

“German Women! England has also declared war on you. She is trying to starve out you and yours by blockading imported foodstuffs. Therefore, to arms! The life and death of the Fatherland now hang no less on you, your loyal will, and your crafts and skills than they hang on victory out there in the battlefield.”[1]

With these rousing words, the Wiesbaden Municipal Commission for National Nutrition set out to mobilize German women – mothers, daughters, and wives – for war. Unlike their compatriots, however, they were not being drafted into military service nor even enlisted into the munitions factories which have come to symbolize for many the main war-time contributions of women. Rather, these women were being mobilized for duty within their own private homes. In 1915 the Great War entered the kitchen and as the nation's men settled into the trench warfare which has become so emblematic of this conflict, German

women began their own war of attrition – against privation, hunger, and the nutritional economy of food in Europe's first “total war”.

This paper examines how German authorities sought to manage the health and behavior of civilians during World War I. Given the severity of the Allied blockade, food—its procurement, management, preparation, storage, and distribution—became an overwhelming concern not just among civilians, but also within the upper echelons of the German military. Not only did they fear how food shortages on the homefront might impact morale, politics, and support for war, but they also worried about the material consequences of poor nutrition on the bodies of the nation's citizens. Through an analysis of war-time cookbooks, medical studies conducted by nutritional scientists, and information from the War Foods Office on food production and rationing, this research reveals how different communities of knowledge-experts mobilized German women on the home front for war-time aims. Ultimately then, this paper exposes how the management of food in war-time Germany enabled the imperial government to penetrate and even re-shape that most private sphere of the nation—the home, the family, the kitchen, and the body.

[1] Städtischer Kommission für Volksernährung, *Anleitung zum Wirtschaften in der Kriegszeit, zugleich ein Kriegs-Kochbuch* (Wiesbaden: Heinrich Staadt, 1915), 3.

S055-B

Thu 25 July, 11:00–12:30 • Uni Place 4.204

Chair: Roy MACLEOD | University of Sydney, Australia

Don LEGGETT | University of Kent, United Kingdom

‘[T]he hash and muddle and quackery of our technical side is appalling’: H.G. Wells and the representation of science and invention in war

What knowledge could H.G. Wells bring to Britain's war work? By 1914 he had enjoyed a successful literary career, and rather less enjoyed a spell at the Normal School and a decade teaching science. He recollected in his experimental autobiography that he refused voluntary service or drill work on the home front, and explained he would only join the war effort if he was given the opportunity to use his particular skills: ‘I meant to be used effectively.’ He was outraged at not being invited to work on the development of the tank: ‘it is absurd that my imagination was not mobilized in scheming the structure and use of these contrivances.’ Yet Wells found a path where he could use his creativity both in invention, working on the telepherage, and campaigning for the importance of inventing and scientific organisation during these vital years. Writing to G.K. Chesterton in 1915, Wells reported ‘I'm absurdly busy in bringing together the Rulers of the country and the scientific people of whom they are totally ignorant.’ This paper considers Wells's role in the changing representation of British science and invention at the start of the twentieth century. His credentials as a science teacher, writer and his desire to be elected a fellow of the Royal Society are well-documented by his literary biographers. Patrick Parrinder and David C. Smith specifically draw on this context to shed light on his fictional works. While in the emerging histories of twentieth-century British science he is primarily portrayed as a member of the intelligentsia networks that pursued social and economic reform, and/or as a futurologist prophet whose fictional creations, such as the ‘land ironclad’ (tank), found form in the early twentieth century. Wells's contribution to the representation of scientific research and invention is less clear. Research presented in this paper reveals Wells to be a walking, talking knowledge and idea broker, possessed of literary gifts and a conviction that scientific knowledge and skill were key to Britain's war effort. He presented the case that war was a ‘struggle of invention’, publishing essays and letters in *The Times*, *Daily Chronicle* and a number of other press outlets. With this evidence we may present a new perspective of Wells as a science commentator who actively shaped ideas concerning the relationship between science, warfare and the state.

Robert BUD | Science Museum, London, United Kingdom

The categories of pure and applied science during and after World War I

The categories of pure and applied science which today have become obsolete once seemed remarkably real. Historians such as Graeme Gooday and Sabine Clark have explored the significance of the categories to scientists and administrators during World War I. This paper will examine the distinction within the British public sphere as it emerged in reaction to the horror of war. In particular gas warfare was associated with the application of chemistry. The paper will explore the meaning of discourse in the public sphere and the emergence of a debate about the meaning of the distinction. Many from industry dismissed it, including Lord Moulton of ICI, and Arthur Fleming who established the Vickers research laboratory. On the other hand, lay writers of books during the interwar years such as JRR Tolkien or the Mirror leader writer Richard Jennings were horrified by the experience of the war but willing to celebrate pure science and condemn its applications. Fleming's training in the US and the work of David Rhees on the campaign to popularise chemistry in post-WWI America highlights the possibility of drawing international parallels. The paper will also reflect on how and whether the experience of the US, Germany and France were comparable.

Klaus STAUBERMANN | National Museums Scotland, United Kingdom

Reconstructing HMAS Warrego and the transfer of shipbuilding knowledge

When in 1909 the newly established Australian Navy commissioned five torpedo-destroyers, it was not surprising that shipbuilders from the Clyde successfully tendered for the contract. Glasgow naval engineers did not only study the theoretical and practical foundations of their discipline, such as thermodynamics or hydrodynamics, they were also acutely aware of the significance of shipyard skills and practices. The Australian Navy did not simply want to acquire modern warships, it also wanted to learn how to construct them. Therefore, two destroyers were built in Glasgow, one, HMAS Warrego, was built, taken apart and rebuilt in Sydney, and two more were consequently built in Sydney, based on the experience acquired from reconstructing HMAS Warrego. This paper will take a closer look at shipbuilding skills and practices on the Clyde, examines the Australian Navy's reasoning behind the rebuilding of HMAS Warrego and will follow the careers of its destroyers to their employment in the capture of German New Guinea during World War I.

Commentary: Steven A. WALTON | Michigan Technological University, United States

S056. Medical knowledge traditions at work

Fri 26 July, 14:00–17:30 ▪ Uni Place 4.213

Symposium organisers:

Mark HARRISON | University of Oxford, United Kingdom

John LOURDUSAMY | Indian Institute of Technology Madras, India

Symposium abstract

This symposium will address different medical knowledge traditions, at different kinds of 'work'/functions (such as exchange, institutionalization, marginalization) in the wake of the encounter of non-western traditions with modern medicine.

John Lourdasamy's paper titled 'Minding the Body and Binding the Mind', looks at the ideological background to the introduction of modern

medicine in the Indian context by taking the case of Madras Medical College whose establishment in 1835 marked a decisive moment in the encounter of medical traditions. It explicates the ways in which medical ideas and values were imparted and contested through the agency of an educational institution. It will also elucidate the ideological grounds on which alternative medical traditions were marginalized within a specific locale.

Mark Harrison's paper titled 'Anglo-Indian Encounters at the Dawn of Empire' focuses predominantly on encounters between British medical practitioners and Indian Muslims at the end of the eighteenth and early nineteenth centuries, in both Britain and India. It will concentrate on knowledge in the workplace, whether in the dissecting rooms of English universities, the hospitals of the East India Company or the palaces of Indian rulers. Its aim is to assess the degree to which knowledge of Western medicine was accepted in the Indo-Muslim world and on what terms.

V.R.Muraleedharan's paper titled 'The Tools that Saved Lives', with its emphasis on clinical and diagnostic tools and practices in Madras Presidency, extends the analysis further into the realm of actual practices. The paper will examine the diffusion and adoption of specific medical technologies (namely x-ray, anaesthetics, and incubator) that changed the public image of medicine and popular responses to medical trials and experimentations.

N.Sreekumar's paper titled 'Medicine as Culture and Medicine as Science' would underline the diametrically different approaches to medicine in India. In traditional India, medicine was not just a science, but a way of life. There was a tension between the religious and rational therapeutics. The paper examines how the encounter with modern medicine made this tension more acute and how it impacted on the newly-arriving modern medicine with its unique methodology (philosophy, ethics), therapeutic techniques and approaches (as a science for a modern society)

Renjini Babu's paper titled 'Beyond "invincible" West and "stagnant" East' deals specifically with the Keralam region in southern India. It explores certain historical renderings, both European and local, and highlights the cross-cutting influences of colonialism, missionary work, western medicine and Ayurveda. It expands on how such representations worked reflexively on modern medicine and also influenced the local attempts at 'revitalization'.

S056-A

Fri 26 July, 14:00–15:30 ▪ Uni Place 4.213

Chair: Deepak KUMAR | Jawaharlal Nehru University, India

Renjini BABU | Indian Institute of Technology Madras, India

Beyond 'invincible' west and 'stagnant' east: encounters, representations and the advent of western medicine in colonial Kerala

This paper focuses on colonial Kerala (which included the princely states of Cochin and Travancore; and Malabar which came under Madras Presidency of British-ruled India), in analysing the historical renderings of the medical encounters in the region, the cross-cutting influences of missionary works and the launching of a nationistic medical experiment.

Enlightenment ethos and colonial 'mentalities' at times essentialised local medical traditions as inherently inferior in its 'scientific' content. This paper poses that, not only were there racial connotations in distancing the people of the 'orient', from that of the west, but the same physiological distinctions were also used to establish social inferiority. A critical overview of the writings of Francis Buchanan, William Logan and Francis Day is attempted in this paper to unveil such historical underpinnings.

Missionary endeavours also often complimented colonial representations of local medical traditions. While professional western medicine attracted

the English educated urban rich, the medical missions attended to the diet and hygiene of the masses through the prism of Christian ethics. Even though rooted in absolute faith in 'science', and hegemonising - through its supposed emancipatory and civilising role - western medicine and medical profession had to undergo localisation by adopting and adapting to techniques and methods of local medical traditions, other than borrowing local pharmacopeia. This paper explicates it through the medical writings of Howard Somerwell who was an honorary surgeon of the South Travancore Medical Mission of the London Missionary Society.

On the other side, local medical traditions, particularly the elite forms, fascinated by the western professionalism and induced by its own dynamics, emulated western medicine in a number of ways, in attempts at revitalisation. This led to a stream of imagination for a national medicine, silencing or side-lining the plurality of medical traditions of the locale. This is explicated here by taking up the case of P.S.Varier and the historical narrative around his Kottakkal movement.

Sreekumar NELLICKAPPILLY | Indian Institute of Technology Madras, India

Medicine as culture and medicine as science: an ethical assessment of the cultural encounter between indigenous and modern medical systems in colonial India

A variety of healing systems and techniques —both indigenous as well as foreign—have gained wide acceptance and popularity in India. The earliest contacts with European medical systems go back to the days of early Greco-Roman civilization. Yet, when modern medicine was introduced in India it brought about certain conflicts, which have cultural and moral connotations. They spurred historical changes that had substantial impacts on the lives of people in India. This paper attempts to understand some such cultural and moral conflicts faced both by the Indians and the Europeans—predominantly the British - since 19th century owing to certain peculiar features of modern science in general and medical science in particular with respect to their fundamental assumptions, methods and institutional requirements. Unlike the indigenous systems, the modern medicine that was "officially" promoted by the British possessed a far more organized system of knowledge and was employed methodically with incomparable efficiency in tackling certain diseases that contributed to high mortality rates in the sub-continent. Despite this, the local populace viewed it with suspicion and considered it as opposing some of their long established beliefs and conventions. But for the British, the introduction and direct and indirect imposition of modern medicine was an integral part of their overall project in India.

This paper tries to understand the nature of such an encounter of different knowledge systems as an encounter between two cultures that conceive and understand the concepts of illness, health, healing and wellbeing differently, during a period when medicine in Europe was transformed into a science from an art that was more closely linked with cultural and traditional values. The paper also sees it as an encounter between two different philosophies of life and moral frameworks: while the indigenous methods remained tied to the local culture and belief systems, modern medical science projected itself against traditional and conventional wisdom as a paradigmatic knowledge endeavor. The central concern of this paper is to understand the moral conflicts involved in such a scenario.

John LOURDUSAMY | Indian Institute of Technology Madras, India

Minding the body and binding the mind

This paper focuses on the Madras Presidency of British-ruled India and highlights the ideological background behind the introduction of modern medicine, particularly through modern medical education starting with the Madras Medical College. It goes beyond the technicalities of the

founding of the college to look at the underlying rationale and the preceding debates to explicate the ways in which medical ideas and values were moulded, imparted and contested through the agency of an educational institution. The paper traces the roots back to the early 17th century when the British started having mental impact on India through their medical knowledge and skills. Madras was the first presidency to have a hospital established in India in the year 1664. The hospital had served as the nodal centre for all other branches and for the future medical developments in the Presidency. Along with the discharge of medical duties came the need for more local training. The various incremental efforts converged into a momentous one in 1835 when the foundations were made for a fully-fledged medical institution run on western lines. This marked a decisive moment in the encounter of medical traditions as it simultaneously subsumed much of the intellectual contestations of the preceding two centuries and queered the pitch for more. The paper explores the attempts at hegemony, accommodation and flexibility around the establishment of the college, its course curriculum, its admission patterns and in the opportunities it threw open for Indians. It also highlights elements of indigenous responses related to the introduction of anatomy, physiology and midwifery, and to procurement of cadavers. It also analyses the multiple intellectual roles of native practitioners of modern medicine who were carriers of British medical 'ideas and items', and the practitioners of indigenous medical systems who were at times contesting and at other times seeking legitimacy under the new intellectual order. The paper aims to capture the results of the curious indigenous reaction against western hegemony by taking the story up to the year 1924, which saw the establishment of a School of Indian Medicine

Sarah Jane BODELL | University of Warwick, United Kingdom

Changing paradigms of medicine? Medical missionaries and the partition of India

In the aftermath of World War II, the lead-up to Independence, and the violent repercussions of Partition, British missionaries in and around the Punjab proved to be a critical element in a change of historical narrative in the history of medicine in twentieth century South Asia. Medical missionary work during this tumultuous time represents important beginnings in the post-war rise of development projects in South Asia, particularly health related objectives. Times of crisis before, such as famines and earthquakes in the late nineteenth and early twentieth centuries, had created an infrastructure and precedent of missionary aid in western India. Against the background of decolonisation, missionary activities took on a new trajectory in South Asia.

These historical circumstances crucially situated missionaries at a point, by the late 1940s, that would afford them a privileged position and intimate involvement in caring for displaced populations in impromptu refugee camps in the wake of Partition. Missionaries functioned as neutral third parties, able to participate in and coordinate relief and recovery efforts with minimal involvement in intercommunal violence. The knowledge gained during this time gave missionaries a prominent voice of experience in the creation of global health development strategies in the following decades and influenced the position allotted to biomedicine in postcolonial India and Pakistan.

This paper looks particularly at the activities of Church Missionary Society (CMS; an organisation within the Church of England) medical workers in and around the Punjab. The CMS funded, for much of the nineteenth and twentieth centuries, what was the largest medical mission agency in the world, with India serving as one of its largest mission fields (only China ever surpassed it). The Punjab, in turn, suffered the brunt of the worst violence surrounding Partition. Charting the secularisation and Indianisation of its medical missions before and after Independence and Partition reflects the changing discourses of biomedical knowledge in South Asia and reveals an understudied aspect of the effects of decolonisation. Thus, an understanding of medical missionary history in India and Pakistan in the late 1940s sheds light on an important crossroads at which the narrative shifts from colonial to

postcolonial—the Church providing continuity between these two chapters in the history of medicine.

S056-B

Fri 26 July, 16:00–17:30 ▪ Uni Place 4.213

Chair: John LOURDUSAMY | Indian Institute of Technology Madras, India

Mark HARRISON | University of Oxford, United Kingdom

Anglo-Indian encounters at the dawn of empire

This paper will examine cross-cultural encounters relating to medicine at the turn of the nineteenth century, a period in which the East India Company was tightening its grip on India and in which cultural alignments were shifting, sometimes radically. Its main purpose is to examine Indo-Muslim attitudes towards Western medicine and to revisit the more familiar question of British attitudes towards medicine practised by Indians. It seeks to determine the grounds on which certain forms of knowledge were accepted as legitimate and useful while others were rejected. In keeping with the main theme of the conference, the paper focuses on medical knowledge which was actively employed or acquired in the workplace. In this sense it differs from the majority of scholarship which has concentrated on cross-cultural interpretations of texts.

The paper proposes to examine the practice of medicine in the court of the Nawab of the Carnatic, which was a nominally independent state under intense pressure from the East India Company, to which it was heavily indebted financially and militarily. This section of paper focuses on the transition from the second to the third nawabs of the Walajah dynasty and it examines the relative status of medical practitioners of different traditions in the court. The nawabs employed practitioners of Western and other medical traditions, and ostensibly their court was a cosmopolitan place of learning. Beneath the surface, however, tensions were increasingly evident, and this was demonstrated in both the patronage and the practice of medicine. By the turn of the nineteenth century, medical access to the body of the nawab became a battleground for rival factions and ultimately determined the fate of the nawabi.

The second part of the paper will compare with the situation in the court of the Carnatic to other places in which Indian Muslims encountered Western knowledge, for example the hospitals of the East India Company and on travels to Europe. Of particular interest is the account given of anatomy and dissection at the medical school of Oxford University by the traveller Mirza Abu Taleb Khan. The translation of the original manuscript of these travels omits some of the details of this encounter out of consideration for the reader, whom, it was presumed, would find them either distasteful or of little interest. If time permits, the missing portion of the MSS will be translated and analysed.

V R MURALEEDHARAN | Indian Institute of Technology Madras, India

Arnab CHAKRABORTY | Indian Institute of Technology Madras, India

The tools of dominance: the diffusion of X-rays in the early twentieth-century Madras Presidency

The paper extends the analysis of western medicine further in the realm of actual practices involving diagnostic techniques, tools and testing. This would help us understand their role in the practice of modern medicine and its professionalisation. This being the realm where modern medicine and technology came directly into contact with the wider population (beyond the realm of the academic), the paper would bring out the popular perceptions of the power of modern medicine as mediated by these various diagnostic tools and clinical practices in the Madras Presidency. Specifically, the paper will trace the introduction and diffusion of X-ray machines in the Madras Presidency, from early 1900s to early 1930s, through the various policy initiatives made by the colonial

government in enhancing the diagnostic capabilities of physicians and surgeons. Also, the paper will examine the reception of this technology by the medical professionals, their hopes and fears of its potential utility and harmfulness in the practices of medicine. The period 1920s and 30s witnessed strong reactions from Indigenous medical practitioners to colonial government's efforts to reduce their scientific status, and a slow but lukewarm response from the colonial government in according them professional recognition that will license them to practice their medicine. Modern technological tools such as x-ray helped in forcing a resolution over such debates across schools of medicines, and eventually in establishing the supremacy and hegemony of the western medicine over other systems of medicines in India.

Nandini BHATTACHARYA | University of Leicester, United Kingdom

On the job: the practice of pharmacy in colonial India, circa 1890-1944

The pharmaceutical business was a hugely lucrative and heterogeneous one in colonial India. It included a large trade in exports of bulk drugs as well as wholesale and retail trade in Indian and western therapeutic products, proprietary medicines and generic pills of all kinds. The retail trade was carried out by large British and a few Indian importers who often manufactured their own medicines and employed pharmacists trained abroad, their retail units were large, well-lit department store –like (Frank Ross Ltd., Kemp and Co., Bathgate and Co., Smith, Stanistreet and Company, etc.); at the other end of the spectrum was the itinerant practitioner in the local bazaars; within this spectrum the identity, work and training of the retail drug dispenser varied widely.

Any narrative of the practice of pharmacy in the developed world includes the establishment of self-regulating professional bodies, legislation to exclude unqualified practitioners from dispensing, and the publication of trade journals. In a colonial context, the dynamics of dispensing were significantly different from the above trajectory. The apothecary's profession was framed formally within the army in India; in the nineteenth century, the military department of the government was also the principal distributor of imported therapeutic products to civil hospitals and government-aided dispensaries. In the open market, barring a few exceptions, the pharmacist's training was often rudimentary and dispensing was learnt through an informal apprentice system. In the twentieth century, the burgeoning trade in pharmaceuticals occasioned intense debate on the need for control and professionalization of the occupation of pharmacists both within the industry and from concerned nationalists, consumers, and even, occasionally, the colonial government. The public discourse on the training, qualifications, and the role of the pharmacist included debates within the medical profession, in the legislative assemblies and in the English and the vernacular press. In this period, the profession of Indian pharmacy was the object of great scrutiny, discussion, and eventually, compromise within the medical profession. This paper will examine the changing role and work of the pharmacists in the hybrid pharmaceutical market in colonial India.

B. Eswara RAO | Assam University, India

Tuberculosis sanatoria and therapeutic practices in the Madras Presidency, 1910-1947

Sanatoria - specialised institutions for the treatment of tuberculosis patients based on the idea of 'good food, fresh air and strict medical control' - which was a replica of the European model, were part of specific histories. While providing special care these also played a vital role in spreading the new medical knowledge, theories and technology. Various discourses and opinions evolved particularly on the site, resources and functions of these institutions. Western therapeutic practices specific to tuberculosis were operated in different ways. At one level, the therapeutic measures provided relief to the patients. At another level, they expressed different meanings through their discursive practices such as claiming hegemonic relations over existing medical

traditions and indigenous people. In southern India, on the one hand indigenous medical systems such as Ayurveda, Naturopathy and Homeopathy existed and their practitioners raised their objections and claims against western scientificity in medicine and the associated therapeutic measures. On the other hand, complicated socio-cultural conditions intervened in the colonial government's activities. The primary objective of this paper is to explore the conflict between western medicine and indigenous medicine that led to the emergence of interesting discourses on treatment methods especially drug, diet and therapeutic practices in the sanatoria. This paper also tries to address the question of how these institutions rationalised western medicine and its related scientific, medical ideas, and medical technologies over oriental practices specifically in the domain of tuberculosis care.

S058. Working in science and as art: twentieth-century 'experimental' relationships

Mon 22 July, 11:10–15:40 ▪ Uni Place 1.219

Symposium organisers:

Cornelius BORCK | University of Lübeck, Germany

John PICKSTONE | University of Manchester, United Kingdom

Symposium abstract

Our session brings together historians of art and historians of STM to explore and situate a variety of 'cases' from the late nineteenth century to the present. We range across many knowledge practices -- as seen in botany or technical construction, laboratories or photography -- teasing out the networks of connections between different kinds of producers. We analyse the relationships between 'scientific' and 'artistic' productions, including issues of 'professional' identity and audiences. We also hope to 'connect' our cases, both historically and analytically, so as to provide frameworks for further such experiments.

Plants have long been paradigmatic for questions of aesthetics and accuracy in species depiction, as iconographical symbols, and more recently for notions of sexuality. Around 1900 they were the centre of decorative art, and several analysts have pointed to 'applied art' as one root of abstraction in avant garde painting. In our first session, David Lomas will discuss a Swedish pioneer of abstraction, Hilma af Klint, a trained illustrator for whom explorations of plant forms were especially important.

Artists are now commonly 'embedded' in Labs and Museums, as in other institutions. But to what benefit? -- for the interactive participants or for publics so 'impacted'? Marion Endt-Jones examines the work of Mark Dion and Beatrice Da Costa and others, to elucidate their projects and their self-positionings between the scientists and the publics.

Science-art professionals now, like student of innovation, tend to look forward rather than back; but more than a century ago, especially in Germany and France, experimental aesthetics thrived as various kinds of psychology threatened to displace philosophy as the foundation of 'cultural studies'. Robert Brain explores the significance of these diverse connections and contests, for psychology, for key art producers, and for their publics.

Of all modern visual technologies, photography is most closely associated with realism, but of course it has many other aspects, in labs as well as exhibitions. It could, for example, be an analytical tool, eg for studying 'radiations', where the understandings of 'rays' developed in tandem with understandings of photography. Chiara Ambrosio explores the work of the ex-chemist Alfred Stieglitz, as an inventor, as an analyst of photography as a technical field, and as an avant- garde photographer.

With Cornelius Borck we move to the constructivist world of engineering at the peak of the cold war, with its heightened awareness of the destructive potentials of (military) technology and industrialization. Facing this situation, a number of projects turned to arts for help, but with contrasting epistemologies and material practices. Gyorgy Kepes at MIT, for example, advertised a universal "education of vision", while 'Experiments in Art and Technology' in the New York area, embraced experimental failures as the very aim of art and technology cross overs.

To set the scene and to sketch a frame for the papers and discussion, John Pickstone will use his analyses of working knowledges in the history of STM to suggest how art- work might be similarly analysed, over time. Perhaps if we took fuller account of the structured synchronic variety of practices across the sciences, the arts and 'fine art', we would have better ways of historicising across the wider complex of knowledge practices. That hope we will pursue both for our particular cases, and more generally. In that respect, the Symposium, like much recent art, may evidently be called 'experimental'.

S058-A. Demonstrating natures

Mon 22 July, 11:10–12:40 ▪ Uni Place 1.219

Chair: Robert BRAIN | University of British Columbia, Canada

John PICKSTONE | University of Manchester, United Kingdom

Analysing working knowledges in modern sciences, technologies and art.

As in the historiography of STM, most of the best work in the historiography of art takes the form of case studies -- as our symposium will show. Attempts to generalise across 'the two cultures' or to sketch 'collective' histories are rare, and they are handicapped by reifications of 'Art' and of 'Science' as primary analytical categories, rather than co-creations of the nineteenth century. In this Introductory paper I explore the advantages of analysing 'scientific' practices as descriptive, analytical, syncretical and hermeneutic, and of using the same categories for the workings of art(s). We may thus hope to clarify the processes of creating & communication in the sciences as well as the corresponding work in the arts, including 'fine Art'. We may also help clarify some of the relationships across these fields of work, both among 'professionals' and with/by 'amateurs'.

To this end, I will try to frame both science-works and art-works as 'demonstrative technologies', at least in part. In STM this adjective may refer to mathematical, experiential or experimental demonstrations, or to technical 'prototypes'. What then might make related practices 'artistic' or particularly expressive? Does this frame help us analyse painting, for example, as variously 'demonstrative'? And what might be meant when some kinds of recent art were described as 'experimental'?

By sketching some of these relations, I hope to provide ways of connecting some of the particular lines of enquiry that will be followed and discussed in the rest of this symposium.

David LOMAS | University of Manchester, United Kingdom

The meaning of 'life': biology and abstraction

The Swedish artist Hilma af Klint (1862-1944) is undergoing a major reevaluation that has seen her portrayed as a pioneer of abstraction on a par with Mondrian and Kandinsky. My paper will focus on af Klint's *The 10 Largest* (1907), a series of paintings that are amongst her largest not merely in scale but also in philosophical ambition. The titles she gave to the works denote a succession of stages in a cycle of human life from childhood, to youth, adulthood, and old age. This is represented using an allegorical format in which plant and animal motifs substitute for direct portrayal of the human. My paper aims to investigate 'life' as a theme in nineteenth century biological science and consider its relevance to af Klint's abstraction.

A comparison of *The 10 Largest* with Philip Otto Runge's *Times of the Day* series of engravings that allegorise the stages of human life as times of a day (as well as seasons) and are replete with botanical imagery, serves to underline af Klint's affinity with *Naturphilosophie*. In biology and physiology, such concerns were registered in the study of generative processes and notions of developmental stages - epitomized by the new field of embryology. The first three volumes of Karl Friedrich Burdach's *Die Physiologie als Erfahrungswissenschaft* (1836-38) were devoted to 'the history of life' and dealt in turn with generation, procreation, the development of the embryo, and the ages of man, including death. Recapitulation theory, moreover, proposed that the individual in the course of its development repeats the stages of evolution of the species. With its central subject of a 'cycle of life', *The 10 Largest* can be seen to draw together fundamental themes of generation, growth and evolution that preoccupied af Klint in her other major series *Ur Chaos* (1906-07) and *Evolution* (1908). These works attest to af Klint's awareness of images newly revealed by microscopy that demonstrated the role of the male and female gametes in fertilization and the details of cellular mitotic division. With such recent advances, it must have seemed that life was on the verge of yielding up its last secrets to science.

Among the biological ideas circulating at the turn of the twentieth century, a resurgent vitalism was very congenial to af Klint's pantheistic and spiritual leanings. My paper will argue that vitalism not only informed the content of af Klint's work but also determined its form by fostering a tendency to abstract. (Study of af Klint thus sheds light on the turn to abstraction more generally.) Vitalistic biology fuelled the study of form and pattern in nature, subjects with aesthetic crossovers recognised by a succession of authors, among them Goethe, Heckel, Blossfeld, and Wentworth Thompson. A self-propagating tendril line, especially prominent in the series *The 10 Largest*, is one of several 'abstract' motifs in af Klint's painting that give expression to an autonomous life force. Another is the spiral. Theodore Cook, in *The Curves of Life* (1914), a study of spirals in nature and art, concluded that: 'with very few exceptions the spiral formation is intimately connected with the phenomena of life and growth.' Occurring with such frequency in af Klint's work as to be almost a surrogate signature, even determining the architecture of the temple that was to have housed *The 10 Largest*, the spiral is an abstract distillation of her abiding preoccupation with 'life'.

Marion ENDT-JONES | University of Manchester, United Kingdom

The artist as 'professional dilettante'

This talk will trace the notion of dilettantism in the work of contemporary artists Mark Dion, Margaret and Christine Wertheim of the Institute of Figuring, and Beatriz da Costa. These artists share a profound distrust in categorization and specialization while championing collaborations with professional scientists and civic institutions as well as what da Costa has termed 'public amateurs'. Do such alliances between artists and scientists surrender art to the technocratic, utilitarian functionality and instrumentalism of scientific research? And to what extent do the artists' tools and strategies of curiosity, playfulness, doubt, chance, humour, irony, and metaphor allow for an independent zone of enquiry – a place where neglected, discredited and unorthodox trajectories can be productively pursued? Measuring contemporary examples of the artist as 'professional dilettante' (Dion) against the historical figures of the polymath, amateur and *curieux*, the paper will assess and chart the creative, critical and political potential of 'alternative', artist-led research methods, knowledge production, and meaning making.

Commentary: Edward JULER | University of Edinburgh, United Kingdom

S058-B. Demonstrating technologies

Mon 22 July, 14:10–15:40 • Uni Place 1.219

Chair: John PICKSTONE | University of Manchester, United Kingdom

Robert BRAIN | University of British Columbia, Canada

Physiological aesthetics: experimentalizing life and art in fin-de-siècle Europe

This paper examines how a family of experimental systems developed in nineteenth-century physiology provided avant-garde painters and poets with key material and conceptual resources that enabled the innovations of early modernism in the arts. I argue that the borrowings moved in two directions. First, I show how artists adopted the materialities of physiology -- instruments and techniques-- as a means to undertake new kinds of aesthetic experiments within the specific media of each cultural art. Second, I show how the converse occurred: early modernist experiments in poetry, the visual arts, dance, and music functioned as experiments on life, aiming to alter the human sensorium and to reconfigure both the artist and spectator. In order to make this argument I show how an array of people, concepts and practices that have not traditionally been discussed together belonged to common networks. I also introduce several new areas of nineteenth-century scientific culture that have not been discussed by historians, including the widely held protoplasm theory of life, the epistemology and social doctrines rooted on the physiology and psychology of movement, and more. Besides developing my claims using the methods of cultural history and the history of science, I support my arguments with readings of works of painting and poetry that reveal the implementation of physiological aesthetics, including Edvard Munch's *The Scream*, George Seurat's late entertainment paintings, Francis Picabia's prewar cubist paintings, the free verse of Gustave Kahn, and the vocal performances of F. T. Marinetti and the Futurists. With fresh interpretations of canonical works I aim to challenge entrenched assumptions about the art/science "two-cultures" divide and invigorate dialogue between historians of science and specialists in the history of art, literature, and music.

Chiara AMBROSIO | University College London, United Kingdom

Beauty is the universal seen: objectivity as trained vision in Alfred Stieglitz's experimental aesthetics

A pioneer of avant-garde photography and a former student of the German chemist August Wilhelm Hofmann, Alfred Stieglitz is a prime example of how artists related to, and challenged, the status of photographic representations at the turn of the 20th century. In this paper I examine Stieglitz's contribution to modernist photography and avant-garde art in light of his early engagement with experimental science, and claim that his scientific training shaped his experimental aesthetics. I argue that the conceptual development of his works was strongly informed by an approach to visual representations as experimental practices, which ultimately fed into his own definition of "experimental aesthetics". I conclude with some remarks on how Stieglitz's photography challenged concepts such as scientific observation and scientific objectivity, and suggest possible ways in which the history of photography may offer a productive ground to reconcile historical and philosophical accounts of representative practices across art and science.

Cornelius BORCK | University of Lübeck, Germany

The arts as bridge between the two cultures: the Center for Advanced Visual Studies and the Experiments in Art and Technology

In the midst of the cold war with its accelerating weapons race and in response to an increasingly problematic fragmentation of modern culture, several projects emerged that mobilized the arts for bridging across the gulf separating the „two cultures.“ Among the most prominent count in the US the Center for Advanced Visual Studies (CAVS) at M.I.T.

and the Experiments in Art and Technology (E.A.T.) in the New York area. With the CAVS, the Bauhaus teacher and photo artist Gyorgy Kepes crowned his teaching career at an academic engineering institution, whereas the E.A.T. were conceived within industry by Billy Klüver, electrical engineer at Bell Telephone Laboratories, as loosely connected series of collaboration projects between artists, engineers and technicians. Falling roughly in the same time period, a comparison of both crossovers between art, science, and technology reveals important epistemic as well as aesthetic divergences under the overarching sociopolitical agenda of hybridizing arts with engineering: Kepes advertised a universal visual education that was grounded in gestalt psychology and adopted the more recently developed principles of cybernetics and systems thinking as the means for directly addressing, and overcoming, what he regarded as the crisis of the contemporary chaos. Klüver and artists like Robert Rauschenberg, instead, embraced the very fragmentation of the contemporary and engaged in multi media art projects that resulted in fragile, temporary constellations often destined to failure. And consequently, both projects materialized in very different ways – practically, technologically, institutionally, but also politically, aesthetically and materially. Beyond period specific political, personal or technological limitations of both projects, the comparative analysis thus sheds light on the important epistemic differences between these two art-science-technology crossovers that may inform current debate on similar transdisciplinary engagements.

Commentary: [Boris JARDINE](#) | Science Museum, United Kingdom

S059. Space at work: space programmes, the environment and nuclear technology

Wed 24 July, 14:00–17:30 ▪ Roscoe 1.009

Symposium organisers:

[Roger LAUNIUS](#) | Smithsonian Institution, United States
[William MACAULEY](#) | Independent scholar, Germany
[Robert POOLE](#) | University of Central Lancashire, United Kingdom

Symposium abstract

The symposium will cover the interrelationship between space programmes, environmentalism and nuclear technology in the period c.1945-1995. In the past decade the 'new space history' has sought to study the space programmes of the later twentieth century in full historical perspective, whilst political and environmental historians have become interested in the relationship between space programmes, Earth sciences and environmentalism. Similarly, historians of nuclear programmes have widened their perspectives from science and technology to society and culture, while historians of environmental science and environmentalism have traced back many important developments to nuclear programmes and their unanticipated effects. The age of 'big science' in the 1940s, 1950s and 1960s paradoxically helped to generate much of the information and ideas later adopted by its environmentalist critics.

The first panel, on 'Space programmes and nuclear technology', begins with an overview of the cultural impact of the nuclear weapons in the post-war years (Poole), suggesting that both the space programme and environmentalism can be understood as utopian alternatives to the prospect of nuclear destruction. Other papers discuss the issues raised by the use of radioactive materials and nuclear power on space probes, as markers of the age and character of human civilization for the benefit

of intelligent extraterrestrials (Macaulay) and as controversial reminders of the risks of technological activity in space and of the continuing role of nuclear and military-related technology in the Earth sciences (Launius). Finally, Masco's paper discusses some unexpected links between the nuclear bomb testing programme and the development of new visions of Earth as a planet.

The session on 'Space programmes and the environment' traces links between the two back to the distinctive west coast US counterculture, where space enthusiasts, hippies, new agers and even the odd astronaut came together to work out a distinctively high-tech and high-flying version of environmentalism (Jenks). Environmentalists and others also embraced the concept of 'Spaceship Earth' as a metaphor both for the Earth as a system and for the comprehensive and cooperative approaches needed to maintain it (Hoehler). Designs for habitable spacecraft as they developed from the 1970s in turn drew on conceptions of 'Spaceship Earth' and habitability developed in relation to the Earthly environment (Hauptlik-Meusburger). Finally, the paper by Cirac-Claveras shows how the US and French Earth observation satellites of the 1980s and 1980s both provided data for environmental modelling and drew on environmentally-driven techniques of data-modelling to generate further data.

All told, 'Space at work', for all the progressive ideas and nuclear technologies which helped to drive it forward, developed in some unexpectedly Earth-centred ways.

S059-A. Space programmes and nuclear technology

Wed 24 July, 14:00–15:30 ▪ Roscoe 1.009

Chair: [Jonathan HOGG](#) | University of Liverpool, United Kingdom

[Robert POOLE](#) | University of Central Lancashire, United Kingdom

The atomic crossroads: progress and extinction in the nuclear age

The nuclear endgame to World War II triggered a widespread sense that mankind had reached the crossroads. 'It must be made impossible for war to begin, or else mankind perishes,' warned The Times of London. Bertrand Russell wrote: 'The human race has to choose between utter disaster and unexampled well-being – no middle course is any longer possible.' The title of the manifesto of the American atomic scientists provided one of the commonplace phrases of the early nuclear age: One World or None? The notion that civilization was in a dangerous phase of 'technological adolescence' became widespread: it was a case of grow up or blow up. Paradoxically, fear of nuclear war generated visions of progress as thinkers and activists sought to construct alternative scenarios for survival: the world government movement of the later 1940s; the 'atoms for peace' utopia of unlimited energy and atomic-powered transport; the drive for space travel, which would ensure human survival beyond the Earth; and contact with advanced extraterrestrial civilizations, which would by definition have overcome their own atomic crisis and be anxious to transmit the formula for survival to homo sapiens. Progress beyond the atomic crossroads would be rapid and unlimited, and the favourite strategy was expansion into space. The progressive technological optimism of the 1950s and 1960s, however, was always the anxious twin of an alternative scenario: that of nuclear extinction. The assumption that modern civilization stood at an atomic crossroads pervaded the early nuclear age, with interesting effects on scientific and cultural thought.

[William MACAULEY](#) | Independent scholar, Germany

Humankind's nuclear legacy: the Voyager record, nuclear waste, and deep time

During the late 1970s, public debate and anti-nuclear protests encompassed not only the dangers posed by nuclear weapons but also issues related to nuclear energy, particularly the problem of radioactive waste from reactors and weapons production facilities. In the context of increasing political and public discourse on risks associated with nuclear technology, NASA launched two robotic spacecraft – Voyagers 1 and 2 – to explore the outer planets before leaving solar system to travel indefinitely through interstellar space. As well as a payload of scientific instruments, the Voyager space probes carry a gold plated phonograph record inscribed with a message to advanced extraterrestrials or descendants of humankind. Enclosed within its protective cover, the Voyager Record will last over a billion years and includes a selection of pictures, music, vocal greetings, and sounds to convey scientific knowledge and the diversity of human culture and life on Earth. In addition, a sample of uranium (isotope U-238) is electroplated on the protective cover as a 'radioactive clock' to identify when the spacecraft was launched. In the early 1990s, actors who played a major role in designing the Voyager Record such as astronomer Frank Drake and artist Jon Lomberg participated in workshops, organized by Sandia National Laboratories under the auspices of the US Department of Energy, to design markers for deterring humans from intruding into a prospective Waste Isolation Pilot Plant (WIPP) in New Mexico for the next 10,000 years. Drake and Lomberg played the role of 'experts' in communicating scientific knowledge and expressing judgements about the design and efficacy of markers, including symbols, scientific diagrams and pictograms as well as large-scale architectural structures covering sixteen square miles, to signify the presence of lethal radioactive waste to future generations.

This paper will examine ways in which the Voyager Record and the WIPP marker systems encapsulate not only explanations but also beliefs and judgements on nuclear technologies, space exploration and communication of factual knowledge across deep time. Scientists and their co-workers who designed these messages claimed that nuclear physics and technology are predictable, intrinsically mathematical, and comprehensible to any advanced civilization. Tracing the collaborative design of the Voyager Record and WIPP marker system reveals how nuclear science and its applications were framed not only as a legacy of humankind's technological proficiency but also a threshold for self-annihilation or survival as a species capable of communicating with advanced civilizations and venturing to other worlds.

Roger LAUNIUS | Smithsonian Institution, United States

Reacting to nuclear power systems in space: the public and outer planetary probes since the 1980s

Since the dawn of the space age more than fifty years ago, nuclear power systems have been used for many long duration missions. While these technological systems made possible a myriad of accomplishments in space, especially the successful flights to the outer planets, controversies surrounding the propriety of using space nuclear power sources have periodically arisen and enraged the public. This paper will analyze the use of this technology to power spacecraft and the public debate over its employment.

For the first decade and a half of space nuclear power the public, even though it had an interest in the risk nuclear systems portended, did not register serious misgivings about the use of this technology in space. This changed rather dramatically in the later 1970s in response to two incidents, the 1978 the Soviet Cosmos 954 accident which spread radioactive debris over more than 100,000 square km in Canada and the 1979 Three Mile Island nuclear power plant accident. Accordingly, support for the use of nuclear power in any setting quickly eroded.

Since that time every American space mission—of which there have been six—that used some type of nuclear system elicited important protest efforts. The first example came with the deployment of the Galileo probe to Jupiter in 1989. Because of Galileo's deployment from the Space Shuttle, it would only be able to reach Jupiter using a gravity assist trajectory that required it to pass close to Venus and have two

swings past Earth before sling-shooting on to Jupiter. The possibility for Galileo's uncontrolled reentry into the Earth's atmosphere on one of its flybys added to other concerns. Protesters had a point, Carl Sagan, agreed: "there is nothing absurd about either side of this argument."

Such has remained the case to the present. The launch of the Mars Science Laboratory on November 26, 2011, is only the most recent example of this longstanding debate. This paper will discuss and analyze this issue of the use of nuclear power systems for spacecraft engaged in scientific pursuits.

Joseph MASCO | University of Chicago, United States

Nuclear optics: the politics of exposure and planetary vision

This paper explores the historical role of film and photography within the U.S. nuclear testing program, focusing on its crucial (but little known) role in the production of new visions of the planet. The U.S. nuclear project relied heavily on scientific photography to understand the nature of nuclear effects but it also built itself by creating documentary films (mostly classified and subject to compartmentalized viewing) for specific audiences – military, scientific, political, and civilian. This paper theorizes "exposure" within the test program as the basis for knowledge (across the earth, material, and biological sciences) but also tracks how the global effects and geopolitics of the atomic bomb created a vital new concept of the planetary.

S059-B. Space programmes and the environment

Wed 24 July, 16:00–17:30 ▪ Roscoe 1.009

Chair: Robert POOLE | University of Central Lancashire, United Kingdom

Sabine HÖHLER | KTH Royal Institute of Technology, Stockholm, Sweden

Rebuilding Spaceship Earth: sufficiency and efficiency in the quest for environmental sustainability

In 1966, in the midst of Cold War anxiety, the British economist and political scientist Barbara Ward took up the image of the earth as seen from outer space to describe the delicate political situation of the world: "Modern science and technology have created so close a network of communication, transport, economic interdependence – and potential nuclear destruction – that planet earth, on its journey through infinity, has acquired the intimacy, the fellowship, and the vulnerability of a spaceship." The spaceship reconciled a number of divergent visions of future earth. Next to presenting a 'one-boat' image of humankind, of community and balance of power, the spaceship became a model for sustainable environmental management. At a time of rising environmental consciousness the spaceship combined sufficiency and efficiency ideals of environmental sustainability. While advocates of sufficiency stressed the need for stability through careful resource use and complete material recycling, promoters of efficiency built on development and growth through proficient technological design. Both visions borrowed from the Space Age imagery and the ecologically sufficient and technologically efficient space capsule. Against this background the paper explores the intersections of space technology and ecological research in the decades between 1960 and 1990 with a focus on the design of closed metabolic systems. The paper compares two projects in which the earthly biosphere was experimentalized in the form of self-contained and self-maintained "life-support systems" that could be operated on earth and beyond. Both projects inserted humans into these short-circuited supply systems, for "long-range survival", as system ecologist Howard Odum claimed in 1971. BIOS 3 (USSR, 1960s-1970s) conceptualized human life as biotic mass. In a closed habitat human elements and chlorella algae entered a symbiotic relationship to

maintain a viable atmosphere. Biosphere 2 (USA, 1980s-1990s) technologically recreated the major biospheric cycles of the earth on a miniature scale, complete with cycles of soil, air, mineral, water and waste. The figure of the spaceship, so the paper argues, united divergent visions for environmental sustainability through merging subsistence and innovation-based economies. Both projects reconsidered humans' place in nature in different yet related ways, as part of the earth's life cycles and as top of and in control of its food chains.

Sandra HAEUPLIK-MEUSBURGER | Vienna University of Technology, Austria

The quest for habitability

"Early spacecraft had been designed to be operated, not lived in";[1] Mercury astronauts did not climb into the spacecraft, they put it on.[2] In the beginning spacecraft design was primarily functional. After the first space missions, when NASA and the Soviets were advancing their goals for long duration missions to prove that humans could live and work in space for extended periods, the habitable design of the interior became increasingly important. The term 'Habitability' – a general term to describe the suitability and value of an environment for its inhabitants – slowly found its way into the vocabulary of spacecraft designers and engineers.

Habitability and human factors are important determinants for the design of any inhabited structure or human-used object, but beyond Earth only the habitat can secure the basic requirements of humans' existence. Isolated from the Earth, astronauts live for a long time in a small and confined environment, completely dependent on mechanical and chemical life support systems. Therefore this kind of habitat is especially subject to careful design, planning and building. Habitability has become an important design issue.

Today we look back at a series of inhabited space habitats – as well as the presently orbiting International Space Station. What has been learned, what has been improved and what – following the experiences of the astronauts and cosmonauts – still needs to be developed?

With this presentation, the author will outline the demanding relationship between the inhabitant and the built environment and the growing importance of habitability throughout the history of spaceflight as summarized in a previous evaluation of space habitats.[3] The author will further review selected designs and recommendations for improving the standard of living and working onboard the International Space Station today.

[1] Compton, et al., *Living and Working in Space, A History of Skylab*, 1983 p. 130

[2] John Glenn, 1962

[3] Häuplik-Meusburger, *Architecture for Astronauts*, Springer Press, 2011; Selected case studies were: Apollo Spacecraft and Lunar Module, Salyut Space Station, Skylab Space Station, Space Shuttle Orbiter, Mir Space Station and the International Space Station.

Gemma CIRAC CLAVERAS | Centre Alexandre Koyré, France

Satellites at work. The environmentalisation of satellite technology and space science: ocean altimetry at CNES

In 1981 the French Space Agency (CNES) circulated the French scientific community for ideas concerning Earth observation missions in order to define the scientific framework in which space missions would be integrated in the following 10 years. A geodesic laboratory proposed the realization of an altimeter, called Poseidon, to be carried on one satellite of the SPOT family, aiming to measure the distance between the surface and the satellite and hence contribute to developing a model of the geoid. The oceanographic community also joined and supported the project, as the measured distance permitted estimates of the sea level,

which could give some clues on oceanic topography and circulation. It was eleven years later, in 1992, that the instrument Poseidon was finally launched, not on board a SPOT platform but as a part of an ambitious NASA's project, Topex/Poseidon. In 1999, after some years of observations, scientists in France and US separately published a similar result: sea level was rising at a rate of about 2-3mm/year. This figure was taken by the IPCC as evidence of global warming, included in its influential assessment report of 2001 (reiterating it also in 2007). Sea level rise became one of the key symbolic facts of environmentalism, a partisan object incarnating the existence of severe climatic change.

Satellites became the definitive technological vectors through which the sea level rise was brought to light. Actually, some tide gauge measurements made *in situ* already existed before the space age – which also indicated a tendency to sea level rise; nevertheless, it was the rise detected from space that was incorporated into the climatic change infrastructure. However, was this environmentalisation of a scientific result in turn taken by the space agencies and scientists to frame future satellite programs and research? Did scientific data resulting from Topex/Poseidon, considered as a herald of the global warming tenet, fuel the technological machinery to generate more data to support or modify those ideas? Satellite technology generated data, but was it at the same time conditioned by the data? In this paper I explore the considerations involving the selection and the conception of space missions at CNES, focusing in the altimetry missions as a case study, and examining to what extent environmental questions influenced satellite technology and space science development.

S060. The transmission of medical knowledge in the Islamic world

Tue 23 July, 14:10–Wed 24 July, 10:40 • Roscoe 1.010

Symposium organisers:

Pauline KOETSCHET | French Institute for Oriental Archeology (IFAO), Egypt

Peter E PORMANN | University of Manchester, United Kingdom

Symposium abstract

In the history of science in general and the history of medicine in particular, translation played an crucial role. It often was through the contact with other cultures that scientific and medical ideas developed. The present symposium focusses on the transmission of medical ideas, and breaks new ground in that it challenges the facile idea that medicine was transmitted from Greek into Arabic and hence into Latin. In fact, a multiplicity of encounters took place that included Ancient Egyptian and Indian material. Furthermore, the concrete examples of Ḥunayn ibn Isḥāq, ʿAbū Bakr Muḥammad ibn Zakariyāʾ al-Rāzī, and Qusṭā ibn Lūqā demonstrate that Arabic-speaking physicians in the Abbasid Empire did not merely transmit previous knowledge, but in fact engaged with it critically. This critical engagement is also visible in the many Arabic commentaries on the Hippocratic Aphorisms, thus showing that commentaries often constituted venues for innovation and change. One can perhaps even perceive here certain aspects of evidence-based medicine. Finally, European university medicine drew heavily on the Arabic medical tradition, and vice versa, as examples from the Ottoman period illustrate.

S060-A

Tue 23 July, 14:10–15:40 • Roscoe 1.010

Chair: Salim AL-HASSANI | The Foundation for Science Technology and Civilisation, United Kingdom

Okasha EL DALY | Qatar Museums Authority, Qatar

Medical knowledge from ancient Egypt to Islam

Ancient Egyptian medical knowledge was widely known in the ancient world and Egyptian doctors were in great demand outside Egypt. Egyptian medicine was taught to Greek students in Alexandria in both Egyptian and Greek languages to make use of Egyptian medical texts still relevant and considered advanced. The fame of Egyptian medical knowledge was such that medical books (papyri) were later translated from Egyptian into Greek and Coptic and later on Arabic. Medieval historians of medicine such as Ibn Usaiba'a were well aware of the debt to Egyptian medical practitioners. Famous Muslim doctors such as Abd Al-Latif Al-Baghdadi researched Egyptian mummies in the quest for knowledge and to settle anatomical questions. Looking at the line of transmission of medical knowledge from Ancient Egypt to Islam, we can clearly identify Greek and Coptic translations from Ancient Egyptian to Arabic as well as direct experience of practical medical knowledge which was still prevalent in the Nile Valley.

Ahmed ETMAN | Cairo University, Egypt

Alexandrian medicine in Baghdad

After many fires in Bibliotheca Alexandrina it has been thought that the Alexandrian Medical Tradition was absolutely lost. Yet the Arab writings and practical activities in medicine showed that the Alexandrian school of Medicine was well known and revived in many centers, especially Gundisabour, Edessa (Roha), Harran and Baghdad. There are many questions without decisive answers till the present moment. What are the characteristics and achievements of Ancient Alexandria in medicine? How the Alexandrian Medical Tradition survived? What about "The Jawami (Summaries) of the Alexandrians" الإِسْكَندَرِيَّةُ دِينِ جَوَامِعِ؟ Who achieved them? How they were transmitted into Arabic? The present paper will try to give some answers.

Peter E PORMANN | University of Manchester, United Kingdom

The transmission of medical knowledge through the Hippocratic Aphorisms

The Hippocratic Aphorisms had a profound influence on subsequent generations; they not only shaped medical theory and practice, but also affected popular culture. Galen (d.c.216) produced an extensive commentary on this text, as did other medical authors writing in Greek, Latin, Arabic, and Hebrew. The Arabic tradition is particularly rich, with more than a dozen commentaries extant in over a hundred manuscripts. These Arabic commentaries constituted important venues for innovation and change, and did not merely draw attention to scholastic debates. Moreover, they had a considerable impact on medical practice, as the Aphorisms were so popular that both doctor and patient knew them by heart. The present paper will highlight a number of examples that illustrate how this rich commentary tradition can be interpreted and analysed in an interdisciplinary way. It will address the question how the medical exegetical tradition, as exemplified by the Arabic commentaries on the Aphorisms, functioned and developed over time. It will produce evidence for innovation and change in what is sometimes regarded as a scholastic genre. These innovations occur on the level of theory, practice and social interaction.

S060-B

Tue 23 July, 16:10–17:40 ▪ Roscoe 1.010

Chair: Mohamed EL-GOMATI | University of York, United Kingdom

KATOUZIAN-SAFADI Mehrnaz | CNRS, France

Al-Rāzī, between a meticulous reading of ancient texts and daily practice: how to build up a therapeutic solution

In the medieval period, Muhammad Zakariyyā al-Rāzī (865 – 925) reveals himself to be one of the great readers of ancient writing translated into Arabic and particularly of Galen's work. It must be noted that Rāzī is the author of a treatise "On accounting for Galen's extant books which are not mentioned by Hunayn or Galen in his catalogue". This is confirmed in his different books, in his Aphorisms and in his personal notes, brought together in a book after his death, called in Arabic *Kitāb al-Hāwī fī al-tibb*, *Continens* in Latin or *The Comprehensive Book on Medicine*. In his works Rāzī, insists that young physicians should complete their education by continuous reading of their predecessors' works and by personal everyday practice. We will study medicinal treatment in the cases of smallpox, asthma, and intestinal disorders and analyse al-Mausūrī, *The treatise of smallpox and measles*, *The book of division* and *Kitāb al-Hāwī* or *The Comprehensive Book on Medicine*. The following points are to be developed: the selection of medical literature by Rāzī, the retention of various experiences and the therapeutic selection for his own practice. This examination will lead to a better understanding of Rāzī, how his respect for the ancients is combined with innovation, creativity and the research of new solutions in therapy and particularly in drug therapies.

This presentation is based on work co-authored by Gouet-Ben Ghachem Asma.

Pauline KOETSCHET | French Institute for Oriental Archeology (IFAO), Egypt

Al-Rāzī's path to medical knowledge

Al-Rāzī (m. 925) is known as one of the most prominent physician of the Arabo-Islamic Middle-Ages. Although he believed experience played a central part in the building of medical knowledge, he also defended the need for moder physicians to appropriate the legacy of the Ancients. This paper will examine al-Rāzī's dynamic relation to the Greek sources, especially Galen. It will address two main questions. First, why did al-Rāzī consider the transmission of Greek knowledge as essential, especially when it comes to epistemological debates? Second, how did he relate to this knowledge? Three texts, each one bearing a very different nature, will come under scrutiny: *The Comprehensive Book of Medicine*, *The Doubts on Galen*, and finally the al-Rāzī's abridgement of Galen's *Method of Treatment*. I will try to show that for this author, the Greek medical tradition is a call for expansion and correction.

Y. Tzvi LANGERMANN | Bar-Ilan University, Israel

Mīrāj al-Duā' wa-Mirāt al-Dawā', an unknown and highly unusual medical treatise, and its transmission of Indian medical recipes

Mīrāj al-Duā' wa-Mirāt al-Dawā' survives uniquely in a manuscript at Teheran (Majlis 15637). It was written by one Muḥammad ʿAlī al-Qazwīnī under the guidance (irshād) of his teacher, Izz al-Dīn Abū al-Faṭḥ Nasrallāh al-Musawī, who taught at a madrasa in Karbalā. Al-Qazwīnī praises his teacher for combining transmitted and intellectual knowledge (al-jāmi' bayna al-ma'qūl wa-manqūl). In keeping with this process of harmonization, as well as the literary tradition of works (beginning at least with al-Fārābī) of books whose goal can also be described as al-jāmi' bayna, he is writing a book that puts together supplications and medications (or regimens endorsed by medical authorities). Some (but not all) of his religious advice, which includes a good deal of magic, is indeed connected with the preservation of health. This very unusual and very rich book will be high on my research agenda in the coming years. My first study, whose results I would like to present at Manchester, focuses on the section of the book dealing with "the preservation of health according to the method of the Indian scholars". This part of the book consists of a series of recipes for rasayanas, the Indian equivalent of the elixir, and instructions for their

use. Rasayana are mentioned by a few other authors writing in Arabic, notably al-Bīrūnī in his book on India, in connection with his (highly hostile) account of Indian alchemy. However, as far as I know, no other account is as detailed as that of al-Qazwīnī, which covers some fourteen pages in the manuscript, and includes some chemical recipes and one mantra, transcribed into Arabic characters. This text is an important contribution to our knowledge of the transmission of Indian medicine.

S060-C

Wed 24 July, 09:10–10:40 ▪ Roscoe 1.010

Chair: **Ahmed ETMAN** | Cairo University, Egypt

Rabie E. ABDEL-HALIM | Foundation for Science, Technology and Civilization, United Kingdom

The role of Avicenna's Medical Poem in the transmission of medical knowledge to medieval Europe

With the increased interest in literary studies and the revival of various natural sciences that occurred in the Medieval Arab world starting from the 8th century, a new theme of Arabic poetry flourished with the appearance of a tradition of didactic poems composed by scholars to be used in educating and training their students. Not only numerous medical treatises were rendered into verse to help students memorize basic concepts but also essays on other topics such as Quranic studies, Arabic grammar, history, oceanography, navigation, astronomy and even mathematics. The Medical Poem ("Al-Urjuzah Fi Al-Tibb") of Ibn Sina (Avicenna, 980-1037), the most reputable example of this genre, is the subject of this primary-source study evaluating its scientific value, poetics and pedagogical significance as well as assessing its role in the transmission of medical knowledge to Medieval Europe. In addition to one original manuscript (MS 480/95671/Medicine, Al Azhar University Collection, Cairo) and two modern editions (the first is edited by Mohammed Mostafa Khan, Lucknow, 1845 whilst the second by Jahier and Nouredine, Paris, 1956), an English translation by Krueger (Springfield, 1963) was also studied. Ibn Sina's poem on medicine consisting of 1326 verse, meticulously classified in numerous theory and practice sections, is practically considered as a poetic summary of his encyclopedic textbook: the Canon of Medicine; hence its popularity in the East then the West as a tool in the process of transmitting medical knowledge from master to student. Since first translated by Gerard of Cremona (1114-1187) in the middle of the 12th century, the Latinized Ibn Sina's poem was frequently published in Medieval Europe either independently or combined with the Latinized Ibn Sina's Canon of Medicine or with the Articella; the famous collection of Greco-Roman and Latinized Arabian medical treatises in use in the universities of Salerno, Montpellier, Bologna and Paris up to the 17th century. The study of the Krueger's English edition, primarily based on the Jahier and Nouredine's French translation with frequent references to Medieval Latin and Modern German sources, revealed few places where the full meanings of the original Arabic text were not conveyed. This can be explained by the inherent and twofold difficulties in translating foreign poetry. A list of those places is given together with the suggested corrections.

Prof Salim AYDUZ | British Muslim Heritage Centre (BMHC), United Kingdom

~~WITHDRAWN: The transmission of European medicine to the Ottoman world: the Works of Abbās Wasīm Efendi and some observations on eighteenth-century Ottoman medicine~~

Aileen DAS | University of Warwick, United Kingdom

From philosophical to medical text: Plato's *Timaeus* in Ibn Sīnā's *Canon of Medicine*

Plato's *Timaeus* had a profound influence on the philosophical and medical discourses of medieval Islam. It is unclear whether the dialogue itself was translated into Arabic in the Middle Ages, and very strong arguments have been put forward recently that the only Arabic versions of the text were transmitted through the exegetical treatments of Galen, Plotinus, and Proclus. Galen's principal contribution to the Arabic tradition of the *Timaeus* is to demonstrate the relevance of Plato's text to the fields of medical theory and practice. This paper will show that Ibn Sīnā makes use of certain ideas derived from *Timaeus* when outlining basic medical theories in his encyclopaedic *Canon of Medicine* (*Qānūn fī ṭ-ṭibb*). Specifically, it will be argued that certain aspects of the discussion of pleasure and pain in Ibn Sīnā's *Canon* very strongly resemble Galen's account of bodily sensation in his lemmatic commentary *On the Medical Aspects of Plato's Timaeus*. In general, this paper aims to draw attention to the correlation between the transfer of medical and philosophical knowledge in the Islamic world.

Akihiro TAWARA | Keio University, Japan

Avicenna's denial of life in plants

Avicenna came to an unexpected conclusion in *On Plants* in *al-Shifai'*: that plants are not alive. This judgment is surprising in view of Aristotle's opinion that that which has a soul is alive. This paper shows that there is a development in Avicenna's thought on plants' life. He begins with the Aristotelian view that plants are alive inasmuch as they possess a soul, as we see in his early *A Compendium on the Soul*. He holds this view in *al-Manda' wa-l-ma'ad* and the *State of the Human Soul*. Later, however, he discards the previous idea and concludes that plants cannot be said to be alive. The apparent reason he gives in *On Plants* is the lack of voluntary movement in plants. This rationale alone, however, is too weak to reject Aristotelian tenet. Searching for his real motivation, I assume that this conclusion comes through his investigation on the faculties of the soul, discussed mainly in the first part of the *Canon of Medicine*, which he wrote prior to the composition of *On Plants* of *al-Shifa'*. In the *Canon of Medicine*, he discusses the crucial role of the animal faculties in the maintenance of life. This insight might lead him to think that that which does not have the animal faculties are not thought of as being alive. Avicenna, therefore, had to conclude that plants, which do not have animal faculties, lack the qualifications to be regarded as alive. This paper indicates the importance of considering the influence of Avicenna's medical findings on his philosophical arguments when examining the development of his thought.

S061. Re-creating past science and technology

Sponsoring body:

British Society for the History of Science

Sat 27 July, 09:10–12:40 ▪ Roscoe 2.3

Symposium organisers:

Hasok CHANG | University of Cambridge, United Kingdom

Jennifer RAMPLING | University of Cambridge, United Kingdom

James SUMNER | University of Manchester, United Kingdom

Roland WITTJE | University of Regensburg, Germany

Symposium abstract

In recent decades, many historians have tried to recreate past scientific experiments and earlier technologies. From medieval alchemy to the Difference Engine, re-enactment is used to recover tacit knowledge, mobilise historical scientific instruments and test modern assumptions about early scientific practice. But what exactly does the success or failure of re-enactment teach us? How do we access knowledge about

experiments described in past texts? How should historians handle seemingly absurd experimental claims by past scientists? And if past experiments can be replicated, is it legitimate for historians to vary or extend those experiments to learn more? This workshop, organised by the British Society for the History of Science, explores such historiographical and methodological issues by examining recent attempts to recreate past science. We investigate the value of replication for research, teaching and public engagement - but also its pitfalls.

Panellists will address these questions by discussing and demonstrating their own experience of experimental re-enactment. The first panel focuses on chemistry. Hasok Chang shows how reproduction of forgotten experiments can help recover lost scientific knowledge, while also extending this knowledge through new follow-up experiments: illustrated using electrochemical experiments. Jennifer Rampling asks how far we can reconstruct early-modern practices with encoded procedures and seemingly unattainable ends, based on her testing of alchemical recipes. James Sumner uses re-enactment to introduce nineteenth-century brewing techniques to public audiences, as a vivid way of conveying the credibility problems faced by "brewer's druggists."

The second panel treats the physical sciences more widely. Laurence Totelin asks whether historians have placed too much emphasis on tacit knowledge, taking us through her own attempts to recreate ancient cosmetics and pharmacological recipes. Haileigh Robertson explores the physical hazards of reproducing dangerous or explosive practices: recreating seventeenth-century gunpowder experiments. Using Hertz's experiments on electrical force, Roland Wittje argues that rebuilding historical instruments offers a way of exploring scientific instruments and interpreting practices related to building and using them. The panels conclude with commentary from two pioneers of historical re-enactment: Otto Sibum and Peter Heering.

S061-A

Sat 27 July, 09:10–10:40 • Roscoe 2.3

Chair: Roland WITTJE | University of Regensburg, Germany

Hasok CHANG | University of Cambridge, United Kingdom

Learning new science from old experiments

In addition to giving us a better understanding of past scientists and their work, the reproduction of long-forgotten experiments constitutes a recovery of lost scientific knowledge, and can also lead to an extension of the recovered knowledge by stimulating new follow-up experiments. I will illustrate these methodological points through the case of historical experiments I have been conducting in early electrochemistry based on the work of Volta, Wollaston, etc.

Jennifer RAMPLING | University of Cambridge, United Kingdom

Practically making the philosophers' stone: recreating impossible experiments

Early modern alchemical recipes often describe marvellous effects – the transmutation of base metals into gold and silver, or the production of elixirs capable of greatly prolonging life. Yet what were alchemists "really" making and doing? Some historians of alchemy have tried to answer this question by restaging alchemical experiments in modern laboratories: assessing whether their reading of a source is correct, by comparing experimental observations with the encoded instructions often found in alchemical recipes. However, alchemy presents particular problems for re-enactment – given that its goals are not achievable according to modern scientific understanding, how far can experimental replication take us in this field? At what point did alchemical authors cease to describe their own observations and fall back on earlier (impossible) accounts? And in a modern re-enactment, how can we tell when we have reached the same point? I will illustrate this discussion

using footage of my own attempts at re-enacting sixteenth-century alchemical experiments.

James SUMNER | University of Manchester, United Kingdom

Public engagement in the pub; or, nineteenth-century nostrums in present-day pints

How can re-creating chemical processes help us to work with non-specialist audiences? My academic research focuses on nineteenth-century projects to make chemical analysis and synthesis credible among industrial producers: an apparently dry subject, and one which bemuses many regular attendees of public events on science, who tend to see these approaches as self-evidently sound and useful. Fortunately, my chosen case study offers a beautifully clear opening question: "*Who likes beer with chemicals in it?*" Even those who rush to defend chemical manipulation can immediately see the potential reputational problem; I go on to explain that fears of an unnatural, degraded, or poisonous product have persisted in various forms since the mid-eighteenth century, and discuss some of the strategies used to overcome them.

To emphasise the point, I have developed a somewhat artificial re-creation of how a nineteenth-century brewer might compensate for a weakened product, showing the action of artificial colouring, flavouring, and foaming agents. Since most of my public presentations take place in pub venues, I naturally encourage the audience to apply the same (non-toxic) additives to their own glasses, providing a literally visceral sense of what is at stake. The fact that only a hardy minority ever take me up on the offer of "beer-doctoring" by means of caramel, vinegar, or extract of grains of paradise is, in itself, a useful source of comment.

My presentation will include a brief run-through of the demo as typically performed, before raising some wider questions: is the extensive and acknowledged compromise of historical authenticity (to avoid toxic materials, but also for convenience) justified? Is this serious replication, or mere showmanship? And, if the approach is useful, how could it be extended to other cases and other historical message?

Commentary: H Otto SIBUM | Uppsala University, Sweden

S061-B

Sat 27 July, 11:10–12:40 • Roscoe 2.3

Chair: Jennifer RAMPLING | University of Cambridge, United Kingdom

Laurence TOTELIN | Cardiff University, United Kingdom

Tacitly yours: what I have learned from Cleopatra and her sisters

Ancient pharmacological and cosmetic recipes usually include very few detailed instructions. When I started recreating ancient cosmetics I was expecting to face insurmountable difficulties. However, I quickly obtained rather satisfactory results. Wherefrom did my understanding of ancient processes come? Was it from my experience as a cook? Or maybe from several years spent reading ancient recipes, and somehow developing a way of reading between the lines? Or was I simply choosing the simplest recipes to recreate? In this paper, I ask whether modern scholars have put too much emphasis on secrecy, tacit knowledge, and broken chains of knowledge in their study of ancient pharmacology. I will illustrate my argument with samples of my products.

Haileigh ROBERTSON | University of York, United Kingdom

Replicating early modern experiments with gunpowder

Gunpowder presented a dangerous yet fascinating subject for members of the Hartlib circle and Royal Society in the mid-late seventeenth century. Prominent figures such as Robert Boyle and Robert Hooke conducted experiments with gunpowder and its constituents (saltpetre in

particular) with diverse means and ends. These experiments aimed not only to test and improve the quality of gunpowder (satisfying the utilitarian requirements of Baconian science), but also to demonstrate how gunpowder and saltpetre could be used to explicate causes in natural philosophy, medicine and meteorology. To use Francis Bacon's term, gunpowder was a 'polychrest' substance, providing both experiments of fruit (utilitarian benefits) and experiments of light (illumination of causes). Thus, gunpowder played a key role in the formative period of the Royal Society's promotion of experimental inquiry.

As part of an AHRC collaborative PhD project between the University of York and the Royal Armouries Museum in Leeds, we will be replicating a selection of these experiments. These include Robert Boyle's 'Redintegration' of nitre (1661), in which experiments with saltpetre were used to demonstrate his corpuscular theory of matter; Robert Hooke's 'Gunpowder Trier' (1663), which was intended to provide a new means of determining the force of gunpowder; and experiments to analyse gun recoil in relation to the quantity and quality of gunpowder, as originally conducted by Lord Viscount Brouncker and published in Thomas Sprat's *History of the Royal Society* (1667). Using historical replication, we aim to investigate the fusions of experimental, rational and technical practices associated with gunpowder and its ancillary skills, using contemporary images, artefacts and descriptions as a guide. Through replicating these historical experiments, we gain a unique insight into the nature of gunpowder and, more broadly, the nature of experimental science in the early modern period. However, there are significant challenges, both intellectual and practical, associated with this.

Roland WITTJE | University of Regensburg, Germany

Beyond the linguistic turn: replicating historical experiments and material cultures of science

Historians of science have in recent years shown a growing interest in material culture in the sciences. It has been argued that this engagement with the material world has happened entirely on linguistic terms. Historians have transformed instruments and other scientific objects into metaphors or icons instead of following what could be called a hands-on approach to the materiality of scientific endeavour. One reason for this I see in the general lack of and unfamiliarity with methodologies for such hands-on approaches to scientific objects and the practices connected with them. In my presentation I will share my experiences of replicating Heinrich Hertz' experiments on the propagation of electric force (electric waves) of 1987, and argue for the method of re-building historical instruments and replicating historical experiments as one method for the historian of science to explore scientific instruments and to analyse and interpret practices related to building and using them.

Commentary: **Peter HEERING** | University of Flensburg, Germany

S062. Reworking the history of chemistry: practice, revolution, visualization and exchange

Sponsoring bodies:

Chemical Heritage Foundation

Forum for the History of the Chemical Sciences

Society for the History of Alchemy and Chemistry

Mon 22 July, 11:10–17:40 ▪ Roscoe 2.3

Symposium organisers:

Carin BERKOWITZ | Chemical Heritage Foundation, United States

Jennifer RAMPLING | University of Cambridge, United Kingdom

Matthew Daniel EDDY | Durham University, United Kingdom

Symposium abstract

This symposium, co-organized by the Chemical Heritage Foundation, Forum for the History of the Chemical Sciences, and Society for the History of Alchemy and Chemistry, asks how chemical knowledge is shaped and put to work through interactions between conceptual, practical, economic and political change. Each panel addresses an exciting and developing area in the historiography of chemistry.

A. Practice: Recovering early alchemy and chemistry

Boundaries between different areas of chemical activity are often blurred in the pre-modern world. What was the relationship between theory and practice, or between the mechanical arts and natural philosophy? Did craft techniques become alchemical secrets, or vice versa? Can historians trace these links and recover lost practices? Matteo Martelli questions the decoupling of theory and practice in Graeco-Roman alchemy, Donna Bilak recovers the practical substratum of a famous allegorical treatise, and Cesare Pastorino investigates knowledge production in early modern mining enterprises. Commentary is provided by Jennifer Rampling.

B. Visualising: The matter of form in modern chemistry

Historians are increasingly concerned with the 'hands on' practices required to manipulate matter and formulate theories, and the various graphic tools that helped make conceptual connections between the evidence of the senses and the thinking routines of the mind. This panel examines how core visual tools like diagrams, mental models and tables were learned and used: aiming to identify larger themes relevant to techniques used to visualise matter in late modernity. Alan Rocke explains how mental imagery was used to construct nineteenth-century models of chemical compounds and reactions, Ann E. Robinson examines the pedagogical advantages and limitations presented by the graphic design of the periodic table, and Michel Morange focuses on the explanatory power of graphic structures imported from chemistry into molecular and cellular biology. David Knight provides commentary.

C. Exchange: Global histories of chemistry

This panel explores international exchanges of chemical knowledge, materials and practices by looking at the trials and travels of chemistry outside Western Europe, from the early Middle Ages to the Cold War. The circulation and translation of books, exchange of chemical substances, and attempts to replicate both practices and their meanings have played an important and often contested role, in fields ranging from pedagogy to drug development. Matthew Eddy provides commentary on papers by Gabriele Ferrario on the trade of lapis lazuli between medieval Egypt and China, Yoshiyuki Kikuchi on the international circulation of nineteenth-century chemical textbooks, and Anna Geltzer on collaborative drug development between the US and USSR.

S062-A. Practice: recovering early alchemy and chemistry

Mon 22 July, 11:10–12:40 ▪ Roscoe 2.3

Chair: **Jennifer RAMPLING** | University of Cambridge, United Kingdom

Matteo MARTELLI | Humboldt-Universität zu Berlin, Germany

At the origins of Graeco-Egyptian alchemy: chromatic transformations between medicine and dyeing processes

This paper investigates the practice of early alchemy, by examining how medicine, pharmacology and a broad set of dyeing techniques interacted

with each other in the oldest known alchemical treatises. These treatises were written down during the first to second centuries CE, and ascribed to different authors, including the Greek philosopher Democritus, the Persian “magus” Ostanos and the Egyptian “alchemist” Peibichius. I shall draw attention to some theoretical passages in which the most ancient authors explicitly refer to medical practice in order to explain how to treat different base materials with specific dyeing drugs. In particular the notion of *pharmakon* – both “medicine” and “dyeing drug” – will be analyzed by taking into account specific examples related to some particular ingredients, starting with quicksilver and its role in medical and alchemical writings.

Donna BILAK | Bard Graduate Center, United States

The allegorical laboratory: process and technology in Michael Maier’s alchemical emblem book, *Atalanta fugiens* (1617)

Michael Maier’s extraordinary alchemical emblem book, *Atalanta fugiens* (1617) is best known to historians of science for its fifty exquisite engravings of emblems that visually render the hermetic vocabulary. But the *Atalanta*’s emblems are also paired with scored music for three voices – Atalanta, Hippomenes, and the Golden Apple, the three alchemical protagonists in Maier’s work who represent the elemental triad of Mercury, Sulphur, and Salt. Maier’s work has yet to be studied in its multimedial totality; moreover, scholarship has not advanced beyond considering the *Atalanta* as a fantastical allegorical expression of hermetic philosophy. This paper presents evidence demonstrating that the *Atalanta fugiens* is an allegorically enciphered manual whose synthesis of music, image, and text fully articulates the alchemical system and delineates the laboratory procedures (as well as some of the apparatus) actually used by adepts attempting to produce the philosophers’ stone. It considers the intersection of alchemical theory and the technologies that defined early modern alchemical laboratory operations, as both premise and framework for Maier’s creation of this unique alchemical treatise. From this perspective, the *Atalanta fugiens* opens up new dimensions to our understanding of pre-modern scientific practice.

Cesare PASTORINO | University of Sussex, United Kingdom

Theory, practice and knowledge production in an early Stuart mining enterprise

Recent scholarship in the history of science has brought a new emphasis on practical domains of knowledge production in the early modern period. The work of Pamela Smith has put into focus the value of artisanal implicit and explicit knowledge, what she has called “artisanal epistemologies.” Other authors, like Eric Ash and Tara Nummedal, have explored the blurred boundaries between technical, entrepreneurial and political domains of early modern science in significant case studies. In more radical interpretations, Lissa Roberts, Simon Schaffer and Peter Dear questioned the traditional hierarchies based on the strong dichotomy between theory and practice. Very recently Pamela Long, adapting Peter Galison’s notion of “trading zones,” has described the existence of sites, like “arsenals, mines, workshops, and cities,” where artisans and practitioners of specific crafts interacted on equal terms with learned individuals and natural philosophers. This paper will explore some of these notions, considering the case of an early Stuart mining and assaying project, developed in the years 1607-8, after the discovery of a large silver ore deposit in Hilderston, Scotland. In particular, it will look at the different activities taking place in connection with the project, including ore assaying and testing, administrative supervision and natural philosophical writing. These practices - belonging to technical, institutional and intellectual domains - help to identify mining enterprises and mints as significant sites of experimental knowledge production, bridging distinctions between rigid disciplinary and social demarcations.

Commentary: Jennifer RAMPLING | University of Cambridge, United Kingdom

S062-B. Visualising: the matter of form in modern chemistry

Mon 22 July, 14:10–15:40 ▪ Roscoe 2.3

Chair: Robert G W ANDERSON | Clare Hall, Cambridge, United Kingdom

Alan ROCKE | Case Western Reserve University, United States

Visualization and representation in nineteenth-century chemistry

In previous work, I have attempted to explore historically some of the cognitive techniques that a particular community of nineteenth-century European chemists learned to use, with unparalleled success, to explore a realm of nature that was in principle inaccessible to the direct reach of their senses, namely the world of atoms and molecules. I concluded that the routine use of mental imagery was an essential element of their intellectual toolkit. This paper seeks to extend that study in certain directions, in order better to understand the “middle ground” between sensory perceptions of material substances, and cognitive strategies of how best to understand them. In particular, the paper offers some ways to delineate, in the context of techniques characteristic of European chemists in the nineteenth century, the heuristic interactivity between the ephemeral world of mental images, and the more concrete entities that chemists created to represent those images, namely atomistic paper formulas and three-dimensional molecular models.

Ann E. ROBINSON | University of Massachusetts Amherst, United States

A part yet apart: the placement of the rare earths and actinides in the periodic table

The periodic table is the visual representation of the periodic system. All of the elements, natural and artificial, radioactive and not, fit into this system. However, in the mid-twentieth century periodic table, two groups of elements, the rare earths and the actinides, were placed together outside the main body. These groups are a part of the periodic system yet apart from it. This placement emphasizes some of the unique properties of these elements, particularly their physical characteristics. But it also makes it harder to illustrate the chemical characteristics they have in common with elements in the main body of the table. Various visual strategies have been used in periodic tables to show where these groups would fit into the main table with the intent of allowing users to visualize relationships between the elements. These strategies often differ depending on the intended audience. Those used in periodic tables in textbooks, on wall charts, and in other educational settings are often not the same as those used in tables meant for consultation by researchers. Using popular chemistry textbooks, such as those by Linus Pauling and Wood & Keenan which were used for several decades, this paper will examine the use of several of the visual strategies and their varying levels of success in illustrating how the rare earths and the actinides fit into the periodic system.

Michel MORANGE | École normale supérieure, France

Twentieth-century molecular visualisations in biology

The rise of molecular and cellular biology at the end of the twentieth century was accompanied by a proliferation of molecular representations in books and articles. These representations contributed to the visibility and success of the new discipline. I will focus on two different types of representations: protein structures, and cell-signalling pathways. The representation of protein structures became a major challenge at the beginning of the 1960s, not only from the accumulation of new data, but also because these data were at odds with what had been expected. The representation of protein structures acknowledged a dramatic

change twenty years later through the lonely work of Jane Richardson. During the next thirty years, the representation has remained remarkably stable. In contrast, the representation of cell-signalling pathways was a shared enterprise, parallel to the description of these pathways, and the characterization of their constituents. The origin of these representations will be traced back: although rooted in chemistry, they have acquired specific characteristics. The nature of these characteristics, their explanatory role in extant biology, but also their limits will be discussed. In particular, the relation between representations and the technologies that generate them will be considered.

Commentary: **David KNIGHT** | Durham University, United Kingdom

S062-C. Exchange: global histories of chemistry

Mon 22 July, 16:10–17:40 • Roscoe 2.3

Chair: **Ronald BRASHEAR** | Chemical Heritage Foundation, United States

Gabriele FERRARIO | Genizah Research Unit - Cambridge, United Kingdom

From overseas: lapis lazuli, ultramarine blue and their journey through centuries and cultures

This paper investigates the early history of the pigment known as ultramarine blue and its use, from its first appearance in Chinese cave paintings (2nd–3rd century CE) to the famous description of the technique known as *per pastillum* found in Cennino Cennini's *Libro dell'Arte* (14th–15th century). My discussion will be based on archaeological findings as well as written sources in order to show how the knowledge linked to the production of this highly valued pigment from the semi-precious stone *lapis lazuli* travelled throughout countries and cultures. I shall focus in particular on Medieval Arabo-Islamic sources (Jābir ibn Ḥayyān, Al-Rāzī, al-Bīrūnī, Al-Tifāshī) describing *lapis lazuli* and its features; some significant mentions of *lapis lazuli* in manuscript fragments from the Cairo Genizah; and descriptions of its preparation in Persian bookmaking treatises (Ibn Bādīs, Abū-'l-Qāsim 'Abdallāh b. 'Alī).

Yoshiyuki KIKUCHI | International Institute for Asian Studies, Netherlands

Making chemical technology travel: book illustrations and the teaching of chemical technology worldwide in the mid-nineteenth century

It is now almost a cliché to say that chemistry was esteemed throughout the nineteenth century for its practical values, especially for industry. Nevertheless, not much has been known about the teaching of chemical technology in the century beyond the teaching of chemical principles, training in chemical analysis, and the visit and/or apprentice in chemical works. Important as these elements are, they would not satisfy the needs of those who were really in needs of such teaching. How, for example, could one learn the operation and construction of an apparatus in a factory without seeing “the real thing”? This paper looks at the often neglected role of book illustrations in making chemical technology “travel,” that is teachable in a variety of countries beyond already industrialized regions such as England and France. For this purpose I shall focus on one richly illustrated reference book of worldwide importance in chemical technology published in the mid-century: Edmund Ronalds, Thomas Richardson and Henry Watts, *Chemical Technology, or Chemistry in Its Application to the Arts and Manufactures*, Second Edition, vol. 1, parts 1-5 (London: Hyppolyte Baillière, 1855-1867). *Chemical Technology* started its life as the first edition of a translation of F. Knapp, *Lehrbuch der chemischen Technologie: zum Unterricht und Selbststudium* (2 Bde. Braunschweig:

Friedrich Vieweg und Sohn, 1848-1853) and after thorough revision became an international bestseller, sold in England, the United States and even as far afield as in Japan. By comparing different editions and examining examples of their usage in different pedagogical settings, I aim to answer the following questions: how did Knapp get the idea of using illustrations in his book and his teaching at the University of Giessen? Why did Ronalds and Richardson choose Knapp? What printing technologies made their production possible? How did its revision get momentum from Ronalds' teaching at Queen's College Galway in Ireland? Did their revision substantially alter the character and role of illustrations? Most important of all, what information did readers in different parts of the globe glean from illustrations as well as from texts, and how did they learn to do that? In conclusion I would emphasize the active role of students-readers and of how authors perceive their “backwardness” and “needs” in determining the methods and contents of teaching, making this endeavour a two-way street.

Anna GELTZER | Wesleyan University, United States

Competing rationalities: Soviet-American cooperation in cancer drug development

In 1972, the US and the USSR embarked on an ambitious program of scientific cooperation that included an active exchange in Malignant Neoplasms. A central focus of this exchange was furthering the drug development programs of both countries, and in the subsequent decade leading Soviet and American oncologists swapped chemotherapeutic preparations, protocols and scientific personnel in an effort to not only further the progress of chemotherapy but to provide a paradigmatic model of anti-cancer drug development for the rest of the world to follow.

But while successful interdisciplinary drug development programs were operational in both countries at the time, effective cooperation—to say nothing of the production of a paradigmatic model for the rest of the world—proved elusive. It wasn't just that Cold War tensions erected bureaucratic barriers and strained personal relationships. Nor could the difficulties the exchange participants encountered in their attempts to design joint protocols and agree on common metrics be attributed to the usual difficulties associated with the production of universal knowledge by means of inherently local practices. Rather, as I argue in this paper, the cooperative project was stymied by the absence of a common rationality among the participants. Soviet and American researchers not only adhered to different protocols and employed competing metrics—they also had divergent understandings of biomedical science.

Commentary: **Matthew Daniel EDDY** | Durham University, United Kingdom

S063. The paper world of science in the age of industry and Empire

Tue 23 July, 14:10–17:40 • Roscoe 1.008

Symposium organisers:

Jim SECORD | University of Cambridge, United Kingdom
Konstantinos TAMPAKIS | National Hellenic Research Foundation, Greece

Symposium abstract

The decades from the mid-nineteenth century to WWI witnessed unprecedented growth in international communication: it became a commonplace that the world was shrinking, with new perceptions of time and space. Developments in communication—almost entirely based on the circulation of paper—transformed the sciences, bringing together a far-flung community of practitioners from different countries. What was

the relation between these newly globalized systems of communication and the making of knowledge?

This symposium (2 x 90 min. slots) will explore the relation between science and paper-based communication from 1848 to 1914. Historians have often assumed that this period's most significant communications technologies were the telegraph, the telephone and the radio; but for many years these remained relatively insignificant outside high finance and high politics. The principal innovations involved systems for managing paper. This symposium will focus particularly, but not exclusively, on newspapers, periodicals, textbooks and the posting of letters, as vital methods for supporting unprecedented interaction between scientists and their publics in different parts of the world.

The aim for the symposium as a whole will be to focus on exchange, translation and interaction across national and linguistic boundaries; this is in contrast to much work on scientific reception, which tends to juxtapose findings from single countries. How, for example, did scientists benefit from the increasing ease of sending letters abroad? To what extent was the scientific article, as a relatively uniform unit of knowledge, a new development? How was the international network of scientific translations—centred on French, German and English—established and maintained? How did textbook authors, publishers and popular science writers take advantage of the opportunities for multiple markets? What role did newspapers and other periodicals play in recording dispersed or unusual phenomena?

At a broader level, the symposium will explore the relation between the communication systems for science and the political and economic circumstances of this period, particularly colonialism and global trade. Many contemporaries contested the virtues of the new paper-based technological systems, which often pushed out older cultural forms based on oral communication. The circulation of science in print, which was widely seen as the apotheosis of western rationality, had a crucial part to play. And finally, to what extent did the paper-based systems of the long nineteenth century break down as a result of the First World War and decolonisation?

S063-A. Communicating through manuscript and print

Tue 23 July, 14:10–15:40 ▪ Roscoe 1.008

Chair: Jim SECORD | University of Cambridge, United Kingdom

Jim SECORD | University of Cambridge, United Kingdom

The paper world of science: a brief overview

The decades around 1900 witnessed an unprecedented integration of global communication systems for the sciences. This paper gives a brief overview of the changes that made this possible. The key technologies involved new ways of circulating paper. Imports of wood-based paper from the forests of Northern Europe, Australia and Canada brought cheap newspapers within the reach of new audiences in urban centres throughout the world. International standardisation of postal rates through the Universal Postal Union (f. 1874) made correspondence far more straightforward than it had been before. At the same time, the establishment of extensive systems of translations between the international languages of learning—French, German and English—meant that works in any one of these languages typically became widely available to specialists in many different countries. These international systems, many of them developed for managing colonial empires and networks of trade, were tied to a public science focussed on debates about Darwinism, atomic theory and other synthetic systems, and to laboratory and field work concentrated on issues of standards, hierarchy and distribution.

Konstantinos TAMPAKIS | National Hellenic Research Foundation, Greece

Translating the past into the present: publishing, translation and Greek scientific practice, 1838-1905

This paper proposes to examine how translation and the paper world of 19th century science, affected the practice of science in Greece from 1838 to 1905. It aims to show how translation of terminology and textbook publishing was one of the central ways to accumulate cultural capital as a practicing scientist in 19th century Greece. Thus, scientists recounted their translation efforts in speeches, official addresses and textbooks and were often judged by the merits of their success in that endeavor. In a space that the role of the scientist, as an expert, patriot and intellectual, was being negotiated, the paper artifacts of science such as textbooks came to the fore as both the subjects and the objects of their practice. By participating in the paper based circulation of their ideas, both locally and abroad, scientists managed to establish their field.

As a final note, the Greek case will be contrasted with the happenings across the Atlantic, in the USA. While both spaces were considered borderlands by the scientists working within them, the formation and operation of the two nascent scientific communities followed very different trajectories. In both cases, however, textbooks and their circulation was instrumental in the how science was done during the 19th century. However, in the US, translation was less an issue and the emphasis was given in the communicative and educational aspect of textbooks. By noting the similarities and divergences between the US and Greece, this paper aims to highlight the role of paper communication during the period and show how textbooks acted as the loci for the conversion and establishment of scientific capital.

Deise RODRIGUES | Universidade Federal de Minas Gerais, Brazil

The letters of Agassiz

Louis Agassiz was a Swiss naturalist of great prominence in the nineteenth century. He traveled to important intellectual centers in Europe, such as Germany, France and England, before he established himself at Harvard University in the United States. At Harvard he performed his vast work in natural history. The historiography of science has represented Agassiz as the strongest opponent to evolutionary ideas, particularly in relation to human ancestry, that way he was categorized as "anti-evolutionist" and "racist". I believe the history of science needs to move beyond this representation. Although controversial, Agassiz has made significant contributions with his classification system known as three-fold parallelism. The method was to study the fossil records based on knowledge of geology, embryology and also through his geographical distribution of animal theses, failing to be based only on the system of the surface morphology. Thus, the triple parallelism method is intended to compare the bodies on the anatomy, embryology and geology, to discover the relationship between both the living and the extinct. The purpose of this paper is to review the controversies and the contributions from Agassiz to natural history in the nineteenth century. To this end, I work with sources of symbolic universe of scientific work: the letters written and read by Agassiz and by his interlocutors of private and professional life. The naturalist scientific practice also was the intellectual and creative activity of writing and reading letters. The textual content presents itself rich in cognitive science. Additionally, the correspondences may have the function of bringing the naturalist to reflect on the process of his work and about himself. Therefore, as different of the publications of scientific texts (books and articles), the letters give to the historian the potential to meet more broadly the development by which a scientist arrived at his discoveries and conclusions through reflection of his research practice in reading and writing of correspondences.

S063-B. Newspaper networks

Tue 23 July, 16:10–17:40 ▪ Roscoe 1.008

Chair: Konstantinos TAMPAKIS | National Hellenic Research Foundation, Greece

Joshua NALL | University of Cambridge, United Kingdom

Cables, wires, and paper: mountaintop observatories and the management of astronomical news

The ascent of American astronomy to world-leading status at the end of the nineteenth century has been persuasively linked to the pioneering deployment of novel astrophysical techniques in new mountaintop observatories. But such a move to the rarefied air of high-altitude sites presented problems inherent to their remote location. As most American observatories of this era were dependent upon the munificence of private benefactors, their resident astronomers had to ensure that their work was seen to be done, and deemed to be important. This required the projection of authority over long distances, so that the value of local endeavours and claims for the generation of new knowledge were seen and acknowledged widely.

This paper will argue that astronomers' solution to these problems was the transformation of their isolated observatories into news distribution centres. Disciplinary transformations in the Gilded Age and Progressive Era were, therefore, fundamentally implicated with developments in long-range communications technologies. This was a far more complex process, however, than simply hooking astrophysical laboratories up to the then rapidly expanding international telegraph networks. Generating astronomical news meant forging relationships with media outlets, above all newspapers. But such relationships presented significant challenges to astronomers and administrators keen to carefully manage their public image.

The trials of Harvard College Observatory's high-altitude outpost in Arequipa, Peru, are exemplary of such issues. By exploring the fraught relationship between its first Director, William Pickering, and his boss in Cambridge, his brother Edward, I will argue that differing attitudes and approaches to the distribution of astronomical news shaped both the perception and progress of this institution's early years. William's close relationship with the *New York Herald*, in particular, allowed the near-instantaneous reporting of exciting new planetary discoveries via the newspaper's telegraphically-linked offices in Lima, New York and Paris. But Edward's vision for his South American outpost, which centred on a diligent photographic and spectroscopic survey of the stars, was placed in jeopardy by his brother's sensational use of the *Herald*, and challenged his own careful management of the Boston and New York media. In this way, the movement of astronomical news via cable and paper profoundly shaped Harvard Observatory's astrophysical practices.

Faidra PAPANOLOPOULOU | University of Athens, Greece
Eirini MERGOUPI-SAVAIDOU | National and Kapodistrian University of Athens, Greece

The return of Halley's comet: a view from early twentieth-century Greek newspapers

In early twentieth-century Greece, newspapers were some of the main vehicles for the circulation of ideas about science and technology. Although the country has never been in the forefront of scientific and technological research, the vast amount of newspaper articles on science and technology as well as references to science and technology in other kind of articles, i.e. news items, chronicles, editorials or even advertisements, illustrate how such discussions became part of daily life in order to serve various agendas. Moreover, the study of 'newspaper knowledge' adds to our understanding of the role science and technology played in the formation of modern societies, and of the values and ideas attached to them and communicated to a broad and diverse public. Greek newspapers, in particular, developed a discourse that incorporated the values and ideas associated with the immediate prospects of Greek society.

In this paper we would like to present the results of a study on the return of Halley's comet in 1910 as seen from the Greek generalist press. On May 18, 1910 Halley's Comet was due to make its periodic passage near the Earth. Spectroscopic analysis had shown that the tail of the comet consisted of poisonous gases and extensive news coverage in the daily press spread panic around the world. Newspapers published various kinds of articles ranging from news items about the orbit of the comet from various observatories around the world, historical articles on Halley's previous passages, popular science articles as well as interviews with local astronomers, reports of public events etc. The information offered was often contradictory, as in some cases journalists encouraged 'end-of-the world' scenarios while at the same time they were critical about them. Some blamed foreign astronomers for the dissemination of 'false information' and questioned the scientific status of astronomy, while others promoted local astronomers who reassured the public about the possible dangers. The paper will focus in particular on the the public image of the (local) scientific communities and institutions, the role of journalists as mediators between the science and the public and the use of the daily press by local scientists.

YANG Haiyan | Peking University, China

Publicising *xixue* (western knowledge) in late Qing China

The term 'science' was first introduced into China in 1897, yet in the name of 'xixue' (Western knowledge), or more specifically, 'gezhi' (the Chinese traditional term for scholarship), attempts of publicizing science and technology in China have been made since the beginning of the nineteenth century. My paper will focus on several major newspapers and mass-circulation periodicals of the last five decades of imperial China, to explore the possibility and value of a communication approach for understanding how scientific ideas and technical knowledge were incorporated within a heterogeneous culture, and how they functioned in the formation of that culture's 'modernity'. I discuss firstly the publications of protestant missionaries and foreign merchants, who acted as the vehicles of Western colonialism and global trade. What were their purposes and influences in introducing science and technology into China? Then, in what kind of changing political and social conditions, did Chinese intellectuals begin to build up their own paper-based platform, for their own domestic concerns? Towards the end of the nineteenth century, the simultaneous emergence of advanced printing technologies, evolutionary theory, and the concept of press freedom offered a perfect opportunity for reformers to advocate their ideas. Newspapers and periodicals discussed here include *Shen bao* (Shanghai Journal), *Gezhi huibian* (The Chinese Scientific and Industrial Magazine), *Guowen bao* (National News Daily), *Guowen huibian* (Collection of National News or The Light Seeker), *Xinmin congbao* (Journal of a New People), etc.

Commentary: Marwa ELSHAKRY | Columbia University, United States

S064. Science × medicine: promiscuous objects, entangled problems

Wed 24 July, 09:00–12:30 ▪ Uni Place 3.204

Symposium organisers:

Monica GARCIA | Universidad del Rosario, Colombia

Josep SIMON | Cinvestav, Mexico

Symposium abstract

'Science' and 'Medicine' are two objects of study characterized by great complexity and covering a large territory. But historians have traditionally considered that their professional, cultural and epistemological boundaries could be clearly defined, at least with regard to each other. The distinction between science and medicine, often represented in oppositional terms, is still part of a standard historical narrative, which reproduces this tension and is restrictive in considering the interaction between these two fields and its nature. Thus, for instance, the making of modern medicine through the introduction of laboratory science in medical practice is a classic framework in which 'science' and 'medicine' are considered as two mutually exclusive fields and the latter is subordinated to the former in being depicted as 'applied science'. Physiology and bacteriology have conventionally been the paradigm in this historiographical framework which posits an implicit subordination of medicine to science when not an essential tension. This is currently giving way to a more symmetrical conceptualization, prompted by the study of contemporary developments such as the rise of biomedicine. However, this growing historical literature has not been able yet to reshape the basic framework by which the study of the intersections and interactions of science and medicine are commonly described. The question is historically complex, since historical actors themselves have often built their own scientific or medical identities, precisely in opposition to each other and to a set of distinct skills and practices.

It is increasingly visible that, in spite of the historical differences between science and medicine, these two areas have been far more promiscuous than conventionally held. They can in fact be characterized by a large number of entangled problems, mediating instruments and shared spaces. This symposium is connected to recent calls to overcome the opposition, which has affected science and medicine, but also their respective historians. One of its aims is to bring together different approaches used in the historical study of science and medicine to understand a series of situations involving promiscuity and entanglement in scientific and medical practices.

Guiding questions in this symposium are: How have physics, chemistry, engineering, and medicine mutually shaped each other? How were perceived the different standards of proof in medicine and in the physical sciences? What was the respective role of scientific and medical experts in the definition of health problems and policies? What is the role of quantification and statistics in creating scientific and medical objects of inquiry? What is the role of technology both in the making of scientific disciplines and medical specialisms? How did data and objects flow between medical practice and laboratory science (and vice versa)? What were the most important spaces of exchange and trading zones? How did science, medicine and engineering intersect with economy and politics?

This symposium includes eight case studies which deal with objects and spaces of exchange such as medical geography, nutrition studies, medical physics, forensics, toxicology, occupational and environmental health, tropical medicine, biotypology, epidemiology and statistics, between the late eighteenth century and the early twentieth century in Colombia, France, Brazil, Spain, Mexico, and the African continent.

S064-A

Wed 24 July, 09:00–10:30 • Uni Place 3.204

Chair: Ximo GUILLEM-LLOBAT | Institut d'Història de la Medicina i de la Ciència López Piñero, Spain

José Ramón BERTOMEU-SÁNCHEZ | Institut d'Història de la Medicina i de la Ciència López Piñero, Spain

Laboratories, academies and courtrooms: toxicology in nineteenth-century France

Focusing on French toxicology, this paper analyzes the tensions, trade zones and synergies between chemistry and medicine during the first half of nineteenth-century. First, I analyze the contested status of

medical chemistry in early nineteenth-century France, through two major reviews by Adrien de Lens (1786-1846) and Godefroy Coutanceau (1775-1831) on the application of chemistry to the different branches of medicine. I argue that it would be misleading and simplistic to characterize these authors as "vitalist" for their arguments on the limitation of chemical and physical laws in the explanation of life phenomena. In fact, as many early nineteenth-century physicians, Lens and Coutanceau questioned some recent medical applications of chemistry (particularly when dealing with physiology and pathology) while largely praising the advantages of chemistry in anatomy, hygiene, pharmacy and legal medicine. Focusing on the latter, I deal with the development of chemical analysis in toxicology and I show how chemical tests gained momentum in courtrooms and turned out to be perceived as the most reliable source of evidence in poisoning trials. During the first half of nineteenth-century, this form of proof successfully competed with two other sources of forensic evidence: clinical data and post-mortem examinations. The advances of chemistry in legal medicine were fraught with controversy, which was fueled by the different backgrounds and laboratory resources of nineteenth-century forensic experts, rather than by contrasting ideas about vital and chemical forces. The new high-sensitivity chemical tests required skilled hands and a high degree of competence which could only be gained by continued practice in well-furnished laboratories (like those at the Paris Faculty of Medicine). This was usually beyond the scope of the local physicians and pharmacists who participated as expert witness in poisoning trials. However, local experts could make the most of their direct access to the clinical history of the victims and, sometimes, their advantageous position in post-mortem autopsies. I argue that these features shaped the controversy between Parisian and local experts concerning the different sources of toxicological evidence. Following some of these controversies, the paper also analyzes the abundant and multidirectional flow of information, objects and practices between medical academies, chemical laboratories and courtrooms.

Josep SIMON | Cinvestav, Mexico

Medical physics avant la lettre: training, disciplines, and technology in nineteenth-century France

Standard accounts of the making of medical physics as a discipline have located its birth in the invention of X-rays and the subsequent development of its technological applications. This narrative, generated by contemporary practitioners of this medical specialty, has been endorsed by historians of medicine and historians of science, and has remained unchallenged by the new interest in medical imaging developed within social studies of science. The history of medical physics is still largely unattended for its cross-disciplinary nature, lost between the history of physics and the history of medicine.

In this paper I show that medical physics was shaped as a discipline across physics and medical practice during the long nineteenth century, before the advent of X-rays. Medicine and physics have a long history of reciprocal interactions, but it was in the nineteenth century when 'medical physics' was established as a distinct academic discipline, represented by university syllabi, textbooks, instruments and practices. Moreover, I argue that nineteenth-century physics and medicine are characterized by disciplinary promiscuity, a tension which informs both the shaping of physics as a discipline and the making of medical specialties in this period. The rise of medical physics is connected, on the one hand, to the major role that medical students and medical doctors had in the production and consumption of physics treatises during the nineteenth century, the teaching and learning of physics, and its boost through educational developments which run across secondary and higher education in science and medicine. On the other hand, physics and physicists had in this period a major role in the development of scientific instruments and experimental practices which shaped not only medical physics, but also other medical specialties such as experimental physiology and public health.

This paper combines approaches from the historiographies of the rise of medical specialties and the making of scientific disciplines, and a focus on practitioners' profiles, training, technology, textbooks and practices, to offer new historical perspectives on the making of medical physics for the use of historians of medicine and historians of science.

Stefan POHL-VALERO | Universidad del Rosario, Colombia

Engineering the social machine: thermodynamics, physiological nutrition and public health in Colombia, 1880-1930

Between the late 19th century and the early 20th century, a new cultural framework which crossed boundaries between science, medicine, technology and society started to emerge in Colombia converging in the problem of nutrition. In this context, the old analogy of the human body as a machine started to take a new meaning shaped by, among others, thermodynamics, experimental physiology and comparative statistics. In 1884 the streets of Bogotá displayed the first rails built by a local company, and four years later the first steam engine, built entirely in Colombia. Contemporaneously, the National University of Colombia trained students in civil engineering and medicine who in their early preparation, before specializing in their respective trades, encountered courses such as 'medical physics', where knowledge about the functioning of machines and human bodies converged. Furthermore, the thermal machine analogy also found its way in the physiological study of nutrition charged with social and political implications. This paper explores how the human machine metaphor can be understood as a cultural artefact that incarnated an assemblage of heterogeneous knowledges, practices and instruments and that helped to define new social problems and strategies to solve them. First, the paper explores different places where knowledge about the human body was produced. Besides pedagogical spaces as the aforementioned course of medical physics, I explore sociological reflections and field research performed by physicians, engineers and lawyers about the living conditions of the working class where the human-machine metaphor operated and acquired new meanings. Second, this paper focuses on the laboratory work of physiologist Calixto Torres, who in the early 20th century measured the caloric content of local food, and the capacity of nutrient absorption of high altitude inhabitants from Bogotá and Tunja. Based on statistical comparisons, he concluded that these local "races" were "physiologically degenerated"; they were thermal machines with a low capacity to transform available energy. This kind of work, that produced knowledge about both nature and the social, and that blurred epistemological and disciplinary demarcations, helped to build nutrition as a social problem destined to be solved by public health programs aimed at teaching people how to become efficient machines. Finally, I analyse some of the institutions that were created for this social engineering goal.

Ana Carolina VIMIEIRO GOMES | Universidade Federal de Minas Gerais, Brazil

What was 'bio' in Brazilian bio-typology? Science and constitutional medicine in the 1930s.

This paper deals with the merging of science and medical practices in the 1930s, in the context of the attempts to legitimate biotypology as a foundational medical doctrine for clinical medicine (especially propaedeutic clinics) in Brazil. The aim is to examine how Brazilian physicians mobilized scientific arguments and practices of bodily quantification and statistics to give scientific status to their clinical practices. The most common definition of biotypology is "the science of constitutions, temperaments and characters". However, the term has additional meanings which can be found in the discourses of contemporary physicians. Biotypology also represented 'the scientific stage of constitutionalist doctrine' and was viewed as the transition of the constitutional doctrines from empiricism to science. It was also characterized as "the science of human individuality", "the science of personality", "the science of individual difference" and "the science of the

architecture and engineering of the individual human body". It is notable that in all these definitions, biotypology was often followed by the word "science", with the aim of bringing a new and more scientific outlook to traditional constitutional medicine. At the same time, constitutional medicine, through biotypology, was proposed as a way to overcome the reductionist approaches of some laboratory practices which focused mainly on illness and not on individuals. In this outlook, the individual was a promiscuous object in which science and clinics could meet. The main scientific practices of biotypology consisted of morphological, physiological and, sometimes, psychological measurements, connected with mathematical equations and statistics. Moreover, it used several scientific instruments for body quantification originated in anthropometry (e.g. compass and goniometer), and physiology (e.g. spirometer). All these procedures and theoretical grounds were combined to produce a bodily classification of Brazilians – biotypology was also a "comparative biology of human beings" –, to establish patterns of normality, and to characterize the individual in biological terms. In this paper, I argue that through the entanglement of experimental practices and statistics with the constitutionalist study, i.e. the look at the individual, Brazilian physicians attempted to incorporate a "bio" compound in their ways of knowing and clinical practices.

Commentary: Steve STURDY | University of Edinburgh, United Kingdom

S064-B

Wed 24 July, 11:00–12:30 ▪ Uni Place 3.204

Chair: Stefan POHL-VALERO | Universidad del Rosario, Colombia

Ximo GUILLEM-LLOBAT | Institut d'Història de la Medicina i de la Ciència López Piñero, Spain

Medicine, chemistry and the environment in the Riotinto mines, 1873-1913

This paper tackles the medicine vs. science debate through an exemplary controversy on the potential hazards of copper mining in the late nineteenth century. In my analysis I will focus on the nature of the relationship between chemical and traditional medical expertise in risk assessment, for the case of the *Humos de Huelva*, in the Riotinto mines.

In 1873 the pyrite mines of Riotinto (Huelva) were bought from the Spanish state by The Rio Tinto Company, an international venture of British and German origin. The extraction of copper and sulphur from the mines was then highly intensified and soon became very profitable for the Company. But this increase in activity was very controversial among several local stakeholders.

The Mines included vast territories and would soon become the main international source for copper. However, the ores extracted were not very rich in copper, and in order to obtain a competitive product, big piles of mineral were slowly burnt, producing the so-called *Humos de Huelva*. This method was effective enough to isolate the copper from other components but, at the same time, the fumes involved occupational and public health hazards, as well as destruction of local agriculture.

The controversy confronted local and national political representatives, miners' unions, farmers' organisations, citizens, medical and chemical experts coming from the country's capital, and several international companies involved in the management of the Rio Tinto mines. The effects of this smoke were considered in their multiple dimensions in numerous reports, articles, books and public debates.

In this paper I will focus on the reports drafted by contemporary experts, including engineers as well as members of the main Spanish intellectual authority in health matters: the Real Academia de Medicina. The involvement of this academy was especially important, with several of its members travelling to the mines and drafting reports that subsequently were subjected to in-depth debate. In these works, the discussion of the

respective values of chemical and medical proofs was one of the main issues at stake. The paper analyses these discussions and evaluates their influence on contemporary accounts by other medical and non-medical experts.

Marta MACEDO | Universidade de Lisboa, Portugal

Black bodies as mechanisms of labor: plantation medicine in São Tomé, 1900-1920

Industrial agriculture came to dominate the entire São Tomé's landscape during the last decades of the nineteenth century. In this Equatorial Island, part of the Portuguese African empire, planters, experts, workers, trees, and machines built cocoa plantations as concentrated spaces of modernity. By studying those ecologies, the goal of the present paper is to understand how the entangled technoscientific practices, which range from scientific agriculture and environmental management to public health, built and sustained a specific colonial regime. Such technological systems, aimed at producing the highest amount of quality cocoa at the lowest cost, depended on intensive exploitation of plants and humans. Both were perceived as machines, considered in terms of inputs and outputs. If the scientific knowledge required to make productive cocoa trees has already received academic attention, less attention has been paid to the study of medical expertise necessary to create efficient working bodies. In this paper I will show how the work of doctors was shaped and conditioned by this human built ecosystem, connecting medical knowledge and environment in a single narrative. In the highly controlled and surveyed plantations, doctors found a perfect place to adapt the agronomic practices of record keeping to humans. In an overall context of scarcity, there were quantification instruments, such as tables, charts and maps, even more than microscopes, which served as medical tools. Health issues were tackled as engineering problems, and according to the laws of political economy. Food supplies, representing the largest expenditure of the estates' budget, became a strategic matter. In order to keep the bodies fit, but also to cope with the international criticism that surrounded São Tomé's coercive labour regimes, plantation diets became a State affair in which experts from the Lisbon School of Tropical Medicine played a leading role. Along with food, housing and sanitation was a standard task in the work of medical practitioners. Moreover, such hygiene practices fostered, and confirmed it scientifically, the idea of morally and racial constituted diseases, defining concepts of race that fuelled European colonization in Africa.

Lawrence DRITSAS | University of Edinburgh, United Kingdom

The science and medicine of African trypanosomiasis: a late colonial odyssey

Attempts to understand and control African trypanosomiasis are bound up in the *longue durée* of African development. It is a disease of cattle and people. The link between the tsetse fly and the cattle disease nagana was long known to Africans and their information was reported by European explorers in the early nineteenth century. David Bruce demonstrated the connection between the trypanosome parasite (which uses the tsetse as a vector) and nagana in 1895, while the connection between the same genus of parasites and the 'sleeping sickness' that affected humans was made by Bruce and others in 1903. The impacts of sleeping sickness were problematic for colonial powers and tropical medicine as a distinct discipline grew out of concerns regarding sleeping sickness. The historical scholarship on African trypanosomiasis has set the extension of Western science, medicine and power in Africa during the early colonial period amongst the changing theories of disease aetiology, control and treatment. This paper builds upon this work to examine the post-Second World War period, when increased funds for 'development' brought a renewed emphasis on disease prevention and control activities, including the expansion and reorganisation of research capacity. At this point, the emphasis on ecology, entomology and vector control as the main logic of prevention was reconsidered, and research was redirected at a suite of scientific, medical and veterinary problems

with the emphasis switching to understanding the parasite itself. Over these years, Trypanosomiasis research and control has been approached from a multitude of different perspectives, including vaccine research, environmental management, vector control, human and veterinary medicine (i.e. prophylaxis or treatments) and insecticides. All of these approaches had political, economic and environmental dimensions to them that pertain in distinct, yet linked, ways from the late colonial period through independence. Scientific and medical research into the many facets of sleeping sickness continued through the political transitions while also witnessing changes to the institutional and funding regimes for vector-borne tropical diseases (and specifically zoonoses) more generally. This paper will transit the varied institutional structures of late-colonial Africa directed at the sleeping sickness problem with a view to describe a foundation upon which, or in spite of, later interdisciplinary research structures were formed.

Monica GARCIA | Universidad del Rosario, Colombia

Debating international standards for measuring the effects of economic crises on health

This paper shows first how the League of Nations Health Organisation (LNHO) created the first international standards for measuring the effects of crises on health during the Great Depression. I build on the work of Iris Borowy and Paul Weindling who had shown that sociomedical indicators were introduced in that endeavor. I highlight how the LNHO faced two contentious indicators that showed contradictory results: mortality rates which were declining during the Slump and sociomedical indicators which showed an increase in malnutrition and illness; and how the LNHO reached a consensus given these diverse criteria and results. Second, I will explore the ensuing international debates concerning the study of the effects of crises and health up until the crisis that unfolded in 2008. I will focus on what can be named as the 'Brenner' debate. The American economist and sociologist Harvey Brenner set the controversy in a series of papers in the 1970s where he argued that economic crises cause rise in mortality rates with a lag. Health experts and the newer economists of health working in the US and Europe have been debating Harvey's methods and results ever since presenting opposite outcomes: that it is in times of economic booms that mortality rates increases. The debate is far from over. What makes this case interesting is the fact that the media and policy makers had given far much more attention to Brenner's conclusions or similar since he first published his papers. Relying on the theoretical insights of the sociology of scientific knowledge and the history of quantification and statistics, I identify the way scientists in the US and Europe have forged methods and reached contradictory explanations linking economic crises and health since the Great Depression and the way they argue that 'science', 'objectivity', and 'quantitative methods' are on their side.

Commentary: Josep SIMON | Cinvestav, Mexico

S065. Knowledge between transmission and local cultural boundaries: migrating scientists and physicians in the twentieth century

Tue 23 July, 14:10–15:40 • Roscoe 2.3

Symposium organisers:

Anna PERLINA | Max Planck Institute for the History of Science, Germany

Frank STAHNISCH | University of Calgary, Canada

Symposium abstract

Long-term migration of scientists and physicians affects both the academic migrants and their receiving environments. On the one side, their encounter confronts two different traditions and systems. On the other side, migrating scientists and physicians are also confronted with foreign institutional, political, economic and cultural frameworks when trying to establish their own ways of knowledge generation, systems of logic and cultural mentalities.

The 20th century, in particular, has been called the century of war and forced-migration: It witnessed two devastating World Wars which led to a massive exodus of scientists and physicians from their home countries. Bolshevism in the 1910s and 1920s, Nazism and Fascism in the 1930s and 1940s, but also the massive impact of the Cold War have forced tens of thousands of scientists and physicians away from the Iberian Island, Central Europe, and Eastern Europe to leave their scientific and academic home institutions.

This panel reflects on the multifold dimensions of intellectual migration and illustrate them by relevant case studies from 20th century history of science and medicine. The session as a whole wants to emphasize the impact of scientific migration from an interdisciplinary perspective by first, describing the general research topic; second, showing how new models can thus be applied to historiography and social studies of 20th-century science and medicine; and third, exploring whether new historiographical approaches can provide a deeper understanding of the impact of European émigré-researchers on emerging fields of science, such as atomic and biophysics, information science and neuroscience, etc.

Chair: Frank STAHNISCH | University of Calgary, Canada

Frank STAHNISCH | University of Calgary, Canada

Learning soft skills the hard way: historiographical considerations on the cultural adjustment process of German-speaking émigré neuroscientists in Canada and the United States, 1933 to 1963

Even many historians of science and medicine endorsed, in the recent past, the widespread belief that the exodus of Central European scientists and physicians during the National Socialist Period could be represented as a purely linear equation of subtractions and additions of intellect. This common interpretation followed a simplistic *brain gain model* of the exodus of academics, intellectuals and scientists after the Nazi seizure of power, when most notably the U.S. (in North America) and U.K. (in Europe) were enriched through the process of forced migration. Though this view is not entirely wrong, if a rather quantitative meta-perspective is taken, it remains less compelling, though, when the individual biographies of scientists are taken into account and placed in their historically contingent work environments. This presentation introduces some individual, local and cultural factors that implicated the arrival, acceptance and integration of many German-speaking émigré-doctors and brain researchers, following their exile between 1933 and 1945. When tracing their career paths into the early 1960s, a period, when the scientific research landscapes in Canadian and US-American biomedicine gradually changed, the complex cultural modes, scientific interactions and evolutionary patterns associated with the forced-migration process become obvious. As shall be argued here, the integration of German-speaking émigré-neuroscientists cannot be perceived simply as a supplementation of long-standing North-American scientific traditions in place, but must be described as a very complex *process of acculturation* on multiple levels of the social and cultural organization of American and Canadian academic landscapes.

Cesar ROTA JUNIOR | Universidade Federal de Minas Gerais, Brazil

The Russian/Brazilian psychologist Helena Antipoff and the reception and circulation of intelligence tests in the 1930s in Brazil

- Important educational reforms occurred in Brazil in 1920 and 1930, according to an agenda of modernization and urbanization of the country. Proposals to modernize education were inspired by theoretical, technical and scientific advances in the field of intelligence measurement. These proposals were opposed to humanistic trends in education that were the standard at that time in the country. In this context some instruments for measuring intelligence circulated in Brazil, with the purpose of evaluating intellectual capacities of children in the educational context. The study describes and analyzes the reception and circulation of intelligence tests in the Brazilian school context in the first half of the twentieth century, especially in the state of Minas Gerais. Among the tests that circulated in Brazil in that period we can identify: 1) The *Dearbon intelligence test*; 2) The *Goodenough drawing test* and 3) The *Ballard test*. The aforementioned tests were brought to Brazil by Russian psychologist and educator Antipoff Helena, a former student of Édouard Claparède in Geneva, and former member of the Binet-Simon laboratory in Paris, under the guidance of Theodore Simon. Helena Antipoff migrated to Brazil at the age of 37 and lived in Brazil until her death, at age 82, in 1974, where she developed an important work in the field of educational psychology and special education. We hypothesized that prior experience of Helena Antipoff in Russia, France and Switzerland contributed significantly to the specifics of the reception and circulation of intelligence tests in Brazil.

This presentation is based on work co-authored by Sergio Cirino and Valeria Nhome Meireles Marinho.

David DEVORKIN | Smithsonian Institution, United States

A case study in the transformation of an astronomical observatory: Fred Whipple's 'dear dream'

Of all established American astronomers active in research in the 1940s and early 1950s, Fred Whipple stands out as the most visible public spokesman for spaceflight. Aside from what brought him to this mindset, tolerated but considered quirky among his peers at the time, what is interesting is what he managed to do with it during his career. Here we examine elements of the institution he built at Harvard, the Smithsonian Astrophysical Observatory, starting in 1955, that characterize the newly coined term "space science." Whipple drew in an assortment of people from engineering and science who had academic, industrial and military backgrounds to expand the scope of his observatory as a collection of crossdisciplinary teams in astronomy, geodesy and the mineral sciences in addition to traditional specialties like stellar atmospheres. By the mid-1960s it was the largest astronomical institution (in terms of staff) on the planet. The project orientation of these teams, largely defined by the specific tools they acquired or required for their work, which was defined by contracts with government and military patrons, created a culture that was new to astronomy, and to Harvard. Here we explore the consequences.

Robert W SMITH | University of Alberta, Canada

The second wave: physicists and the remaking of astronomy after World War II

In the middle of the nineteenth century, the enterprise of astronomy was transformed by the incorporation of radical new observing techniques and theoretical methods drawn from physics and chemistry. The result was the emergence of astrophysics. A century later, during the 1950s and 1960s, the shift of many physicists to the pursuit of astronomical researches was allied to other crucial changes in terms of the practice, institutional structures, instrumental basis and patterns of patronage of astronomy so that astronomy was fundamentally remade in these years in both North America and in Europe. The migration of physicists to astronomy in these decades constituted therefore the second wave of the remaking of astronomy by physicists. In this paper, I will focus on this

migration, what drove it, what were its major consequences, and how it compares with the migration of physicists to other scientific disciplines in the years after World War II.

Commentary: **Guel RUSSELL** | Texas A&M University, United States

Commentary: **Alexei KOJEVNIKOV** | University of British Columbia, Canada

S066. Planet Earth, the environment, and the Cold War

Fri 26 July, 09:10–15:40 ▪ Uni Place 2.219

Symposium organisers:

Peder ROBERTS | Royal Institute of Technology, Sweden

Simone TURCHETTI | University of Manchester, United Kingdom

Symposium abstract

Historians have only just begun to explore the unprecedented advancement of the earth and environmental sciences during the Cold War period and beyond. Works on a variety of disciplines have revealed the enormous effort put by sponsors and patrons into the funding of novel research focusing on the Earth - how, quite literally, earth and environmental scientists were put to work in the service of geopolitical ends, from acquiring knowledge of remote spaces to monitoring global environmental systems and controlling natural resources.

In recent years, several teams of scholars in the US and Europe have undertaken significant forays into the history of the environmental sciences in the context of pioneering research projects including (amongst others): *Colony, Empire, Environment: A Comparative International History of Twentieth Century Science*; *Exploring Greenland: Science and Technology in Cold War Settings*; *Large Scale Historical Exploitation of Polar Areas (LASHIPA project)*; and *The Earth Under Surveillance (TEUS): Geophysics, Climate Change and the Cold War Legacy*.

These projects have produced a welcome harvest of new ideas and concepts that have expanded our understanding of the role and significance of the environmental sciences in the twentieth century world. But until now, there has been little opportunity to reflect on what has been learned, and what topics have remained tantalizingly out of reach. What are the major unexplored questions involving the environmental sciences after 1945? What new collaborative research projects are needed?

Answering these questions might be difficult, but we would welcome an effort to chart what is yet to be known. In particular, the aforementioned projects show that while we now know considerably more about the effort put into the funding and development of the environmental sciences in the US and Western Europe, much remains to be ascertained about developments in other regions of the world. This lack of knowledge deeply affects our historical understanding given the global nature of the scientific investigations carried out during the Cold War period, especially through the International Geophysical Year (IGY) and subsequent international projects sponsored by ICSU and other bodies.

We thus call for a symposium discussing how scientific knowledge on the earth and the environment was put together during the Cold War and beyond, looking especially for contributions that can elucidate connections between states beyond alliances such as NATO, or illuminate the earth and environmental sciences beyond western Europe and the United States. We are particularly interested in submissions that consider the role of Eastern European scientists (given their strong

participation in Cold War research), and perspectives from the 'global south' that bring decolonization into focus.

S066-A. A 'Red' International Geophysical Year? Alliances and divisions in episodes of international scientific collaboration

Fri 26 July, 09:10–10:40 ▪ Uni Place 2.219

Chair: **Peder ROBERTS** | Royal Institute of Technology, Sweden

Adrian HOWKINS | Colorado State University, United States

Contested ice and fractured alliances: the Cold War and the Antarctic Peninsula, 1945-59

In July 1948, the Chilean military attaché in Buenos Aires relayed to Santiago reports originating from Radio Moscow alleging that the United States had reached an agreement with Argentina over the sovereignty of Antarctica. Although the Chilean Foreign Ministry regarded such reports as false, the episode was an early example of a number of attempts made by the Soviet Union to take advantage of international discord in the Antarctic Peninsula region to upset the Western alliance. During the 1940s and 1950s, the sovereignty of the Antarctic Peninsula region was contested by Argentina, Chile, and Great Britain – three key Cold War allies of the United States. Although Cold War confrontation never came directly to the Antarctic Peninsula, the politics of the Cold War exerted a significant influence the history of the Antarctic sovereignty dispute: while Soviet propaganda heightened tensions, fears of Soviet intervention at the same time acted as a restraining influence. In turn, the history of the Anglo-Argentine-Chilean dispute helped to shape the history of the Cold War in the Antarctic continent more generally, most obviously by providing the United States and its allies with an important motivation for the negotiation of the 1959 Antarctic Treaty, which suspended sovereignty claims to Antarctica and created a continent “dedicated to peace and science.”

With a particular focus on the connections between science and politics, this paper will examine the history of the Anglo-Argentine-Chilean sovereignty dispute in the Antarctic Peninsula through the lens of the Cold War. All three sides in the dispute used science and the environment to support their respective claims. The Chileans and Argentines, for example, argued that their geographical proximity to the Antarctic Peninsula and the geological contiguity of the Andes Mountains into the “Antartandes” gave them rights to sovereignty that that the British did not have. Such geographical considerations also had clear geopolitical implications: proximity to Antarctica made Argentina and Chile increasingly fearful of Soviet presence in the southern continent, and more concerned about the impacts of possible nuclear testing in the region. This paper will argue that the 1959 Antarctic Treaty can be understood not only as a Cold War document, but as a Cold War document that was refracted through the history of the sovereignty dispute in the Antarctic Peninsula. The history of the Anglo-Argentine-Chilean dispute helps to explain important provisions within the Antarctic Treaty such as suspension of territorial claims and the prohibition of nuclear testing. And the Cold War context helps to explain why countries such as Argentina and Chile were willing to sign and ratify the Antarctic Treaty despite their initial reluctance.

Julia LAJUS | National Research University Higher School of Economics and European University at St. Petersburg, Russia

The circulation of environmental knowledge in a divided world and Soviet ‘scientific diplomacy’, 1956-1966

This paper analyse the role of scientific diplomacy in circulation of environmental knowledge across west-East divide in 1956 - 1966. This

decade was crucial for Soviet scientists in reviving the old ones and establishing new international communications after isolation during the late Stalinist period (1948 - 1953). Moreover, in 1956-57 the Soviet science was able to overcome interwar marginalization, and the Soviet Union was accepted to the main international scientific unions such as ICSU, which was crucially important for Soviet participation in the International Geophysical Year (IGY, 1957 – 58). Necessity to act fast and to combine ability to invoke and keep international connections simultaneously with fostering state patronage in highly changeable and often uncertain political milieu of Cold War encounters put at front the new leaders. They assembled diverse networks which included newly organized or reorganized institutions, well-trained staff many of whom had pre-War field work experience especially in the Arctic and rapidly developed material structures such as large research vessels, observational infrastructures, collections, data storage. Soviet efforts were coupled with a deep interest among many European and American environmental scientists especially in the fields of polar studies and oceanography to the results of Soviet research. Some of them, like British geographer Terence Armstrong, served as mediators between eastern and western scientific communities. This paper is based on archival research and original database of international events in which Soviet environmental scientists participated, translations and reviews of Soviet publications during 1956-1966. I would like to acknowledge support from the Basic Research Program of the National Research University Higher School of Economics in 2012 for the project "Circulation of Knowledge in Divided World: Attraction, Confrontation, Cooperation among Communities of Experts in the Cold War Period".

Doubravka OLSAKOVA | Institute of Contemporary History, Academy of Sciences of the Czech Republic, Czech Republic

A symphony of science or Olympics of science? The International Geophysical Year in central and eastern Europe

In an article published in the *Scientific World* in 1958, Valery Troitskaya, the scientific secretary of the Soviet National Committee of the IGY, described the IGY as a symphony of science. The perception of the IGY in the countries of the Soviet bloc was, however, different, which explains why the Berlin Academy of Sciences used another comparison: 'Olympics of Science'. The East German perspective from below revealed another layer of the IGY because, as we all know, there is one crucial difference between a symphony and the Olympics: Olympics have winners...

The proposed paper focuses on the history of the IGY and activities undertaken within its framework in the Central and Eastern Europe, with special focus on Czechoslovakia, East Germany, and Poland. The introduction presents a short and basic excursion into the history of the ICSU as well as the role of the USSR and their satellites. Under Soviet pressure, Poland, Hungary, and Czechoslovakia left UNESCO in 1952-1953. They were 'allowed' to re-enter it only in 1954 when the USSR, too, became its official member. The situation in 1952-1953 influenced the international collaboration of all these countries and their activities, if any, were rather limited.

The IGY, the idea of which started being discussed in 1953, played a crucial role in the changing framework of international cooperation even within the Soviet bloc. IGY was not, however, very warmly received in Eastern Europe: only Czechoslovakia was interested in participation and set up a national committee in 1953. During this first stage, Poland and East Germany refused to participate. They agreed only under pressure from national governments, which were in turn pressed by Moscow. Despite these difficult beginnings, the collaboration worked very well later on.

The paper outlines the main features of institutional cooperation on IGY activities within the Soviet bloc. It also describes principal areas of activities, collaboration with non-socialist countries, and the impact of IGY on the international community. The IGY started in 1957 and thus overlapped with the process of de-Stalinisation, which opened new

perspectives for scientific cooperation within and outside the Soviet bloc. At the end of this process, a new COMECON structure of scientific cooperation was created.

Sebastian Vincent GREVSMÜHL | UPMC, Paris 6, France

Upper atmosphere research in Antarctica during the Cold War: authority and (non)cooperation

Ozone research is usually considered a very good example for successful cooperation all along the twentieth century between a considerable number of countries on a truly global scale. The work of the British Antarctic Survey (BAS) reveals however a more complicated pattern. In order to be able to speak with authority on upper atmosphere phenomena in Antarctica, ozone researchers from the British Antarctic Survey built up their own rigid set of standard procedures and calibration methods. In particular, they refused at a certain point to communicate their ozone data to the global ozone network in order to avoid "dilution" of their robust data with measurements which they considered mostly of doubtful origin. This "closed world" strategy proved highly successful: in 1985, BAS announced the groundbreaking discovery of annual stratospheric ozone depletion above the Antarctic continent – well before other "competitors" (such as NASA's ozone group) were able to publish on the phenomenon. Revisiting the history of this important environmental discovery may help identify quite different institutional strategies of evidence production and patterns of highly selective cooperation efforts in order to build up authority in a clearly delimited research field.

Commentary: Peder ROBERTS | Royal Institute of Technology, Sweden

S066-B. Resources and national security

Fri 26 July, 11:10–12:40 • Uni Place 2.219

Chair: Simone TURCHETTI | University of Manchester, United Kingdom

Roberto CANTONI | University of Manchester, United Kingdom

The Algerian war: a tripartite struggle for energy

The historiography of the Algerian war (1954-1962) has tended to focus on political, diplomatic, military and cultural aspects: while most works on the conflict regard strictly French-Algerian relations, attention has been given especially in the last decade to international implications. However, two topics have been surprisingly neglected, whose importance can hardly be overestimated: the search for energy resources and the security issues connected to it.

The struggle to access oil and gas exploration in the Algerian Sahara has been essential to the development of the conflict: it predates its diplomatic internationalisation, marked by the French bombing of the Tunisian village of Sakiet Sidi Youssef in early 1958, and provides a telling example of the dynamics involved in a transnational network of knowledge exchanges.

Hydrocarbon exploration is closely linked with issues of French national security, as the Sahara was one of the French areas, on which France was aiming at building up its energy autonomy from the Americans. In my paper, I look at processes of political decolonisation and concurrent *oilisation* of Algeria, focussing on the role of the institutions and oil companies from the three countries mainly involved in these issues: France, the US and Italy.

The collection of intelligence on the Algerian subsoil carried out by US diplomats and oil companies, together with the prominent role of the US in the Cold War, gave the Americans a favourable opportunity to enter Algeria. Such move was further helped by the French need for financial and technological resources to carry out a thorough exploration of the

geologically complex Saharan area, which forced French administrations to modify their Saharan policies according to the current power relations.

At the same time the Italian public oil company, willing to carry out a policy of expansion of national industrial interests to the Mediterranean, started daring negotiations with the Algerian fighters in order to achieve exploration advantages after independence, at the expenses of the French. The Italians helped the Algerians educate their oil élites and frame a picture of the energy possibilities of their land, through several intelligence exchanges between Algerian leaders and Italian geologists-geophysicists.

By the end of the Algerian war in 1962, although the French managed to keep a priority position in the post-colonial oil market, the Americans would hold a considerable stake in the Algerians resources. The Italians, despite giving up oil exploration in Algeria after the death of their oil company's charismatic president, would still keep close relations with the administration of the new country, ultimately shifting their interest to gas.

Matthew ADAMSON | McDaniel College, Hungary

Uranium the integral element: the geophysics and geopolitics of the Franco-American effort to prospect for uranium in Morocco in the 1950s

While the recent history of Morocco, including its contested *de facto* colony of the Western Sahara, involves international power struggles over mineral resources, those resources rarely feature in historical accounts, which tend to be very partial in terms of periodization, regional focus, or general topic. The search for and exploitation of mineral resources are often treated as the static background of a larger geopolitical story in which colonization, the Cold War, and decolonization are seen as the historical processes to be understood.

In this paper I examine the history of uranium prospection in the early Cold War in Morocco. In this unique case, Morocco's status as a protectorate was of decisive importance in the development in the 1950s of an unprecedented collaboration between the French and American atomic programs to prospect for uranium. This prospection program did not last; the reality of low-grade deposits, untrusted refining techniques, as well as the last push towards Moroccan independence, led both sides of the collaboration to call a halt. Interest in Morocco's uranium revived in the 1970s, but even today a combination of technical and political factors leave those uranium minerals – even those locked in Morocco's abundant phosphates – dormant in their beds.

Lino CAMPRUBÍ | The Earth Under Surveillance / UAB, Spain

Resource geopolitics: geophysics and (re)colonization in Morocco and the Sahara

This paper is tightly related to Matthew Adamson's in this same panel. We both look at the region of Morocco and Western Sahara and we both look at resources to shed light on their recent common and conflictive history. Moreover, uranium and phosphoric acid were connected in the region's resource history. The recent history of Morocco, including its contested *de facto* colony of the Western Sahara, is linked to international power struggles over mineral resources. Yet those two rarely come together in historical accounts, which tend to be very partial in terms of periodization, regional focus, or general topic. The search for and exploitation of mineral resources are often treated as the static background of a larger geopolitical story in which colonization, the Cold War, and decolonization are seen as the historical processes to be understood.

In this paper I address Western Sahara geopolitical stalemate putting the focus on the role of phosphates. I describe the Spanish geological explorations that led to the first discovery and the geophysical international cooperation that resulted in what would prove to be the really significant finding: the Bu-Craa mine. I then examine how this mine altered the geopolitical equilibrium revolving around the phosphate world market in the eve of the Green Revolution. I conclude by stressing how the alternatives opened to restore this geopolitical equilibrium are behind

Morocco's seizure of the territory in 1975, for which it found the support of Spain, France and the United States.

Commentary: Simone TURCHETTI | University of Manchester, United Kingdom

S066-C. Environmental monitoring and the ideological battlefield in the environmental sciences

Fri 26 July, 14:10–15:40 • Uni Place 2.219

Chair: Jacob HAMBLIN | Oregon State University, United States

Martha SMITH-NORRIS | University of Saskatchewan, Canada

US nuclear tests, the environment, and medical research in the Marshall Islands

Despite the international trend towards decolonization after World War Two, the United States maintained control over the Marshall Islands throughout the Cold War. As tensions with the Soviet Union escalated, the Americans conducted a large number of nuclear experiments on the Bikini and Enewetak Atolls in order to develop an arsenal of nuclear weapons. On March 1, 1954, the United States detonated BRAVO, a 15 megaton thermonuclear weapon on the surface of Bikini. As a result of this massive explosion, hundreds of Marshallese living on the nearby atoll of Rongelap were exposed to large doses of fallout. Although the U.S. Atomic Energy Commission failed to evacuate the Rongelapese in a timely manner (they were left on their atoll for 50 hours), it moved quickly to create a research team capable of studying the exposed islanders. One week after the BRAVO test, American scientists began examinations of the Rongelapese and established a control group for comparison purposes. In 1957, the United States returned the exposed Rongelapese (and a new control group) to their contaminated atoll with the expectation that the islanders' intake of certain radioisotopes would increase after resettlement. As Dr. Conard, the lead scientist, explained: "The habitation of these people on the island [Rongelap] ... affords a most valuable ecological study on human beings ... various radioisotopes can be traced from the soil, through the food chain, and into the human being." In particular, these studies indicated significant increases in the levels of radionuclides such as Cesium 137 and Strontium 90 in the bodies of the Rongelapese. By the 1960s, when scientists started to observe high rates of thyroid cancers and other abnormalities in the exposed islanders, they concluded that the primary cause of these conditions was prolonged exposure to radioactivity. Rather than provide the afflicted Rongelapese with adequate medical care (or remove them from their contaminated atoll), the Americans continued to use them as research subjects. As a result of these medical studies, the United States gained important scientific knowledge about the immediate and long-term effects of human exposure to fallout from thermonuclear weapons. During the Cold War, the health and welfare of the Marshall Islanders was considered secondary to the geopolitical interests of the national security state.

Elena ARONOVA | Max Planck Institute for the History of Science, Germany

The Cold War and the politics of big data: the history of the Global Network for Environmental Monitoring project, 1960s-1970s

This paper examines the history of the attempt to launch an ambitious international project, the "Global Network for Environmental Monitoring," initiated within the International Biological Program in 1969. The project entailed the establishment of a world-wide network of monitoring stations in order to collect data on the physical and biological environment. In this paper I will discuss the ways in which this project, envisioned during the

Cold War, epitomized some of the deep Cold War concerns and sensibilities, in a somewhat counter-intuitive way. The negotiations and the discussions on this project at the meetings of its planning committee, which included the representatives of the USA, USSR, and Sweden, show how the Cold War geopolitics provided incentives for dissolving various boundaries: national boundaries, through the establishment of the "global network" of stations, as well as disciplinary boundaries, through the aspiration of its founders to blur the boundary between the physical and biological environmental sciences. The history of the planning, transformation and ultimate implementation of this project in a form very different from the one planned originally, provides an opportunity to discuss the complex relation between knowledge about the globe and global politics, in the age of the Cold War.

Anna AMRAMINA | Schmidt Institute of Physics of the Earth, Russia

The Cold War: closing chapters. Joint Soviet-American experiments in underground nuclear testing

In 1985, after a long and eventful history of competition and controversy in the field of nuclear testing the USA and the USSR signed an agreement to hold joint experiments in underground nuclear test verifications which proved to be not only a successful research project but a milestone in Soviet-American political relations in view of the Cold War. It also had a considerable impact on the life of academic community of both countries.

At the time in modern history when the prospect of the Cold War became catastrophic neither of the two biggest opponents could offer a solution acceptable to the other party. The nuclear test ban negotiations came to a deadlock. Both the United States and the Soviet Union were taking unilateral measures to solve the issue in the atmosphere of mutual mistrust and suspicion. Strange as it might seem, the ice broke after a series of joint experiments on verification of underground nuclear explosions, which, from the scientific point of view, could hardly be considered a brain-taxing problem. The geophysical issues behind the experiments were already being discussed in the academic community. Nevertheless, it seems that it was American and Russian geophysicists, academic officials and public activists from the Natural Resources Defense Council (NRDC) and the Soviet Academy of Sciences who initiated and executed this project whereas politicians had striven and failed. Is it merely a coincidence or an indication of a modern tendency of science's growing influence on politics?

With this question as the focal point, this research aims to create an objective account of this unique experience for American and Soviet researchers. It is an opportunity to compare and contrast seismology, technology and people on both sides of the Iron Curtain. It is also a chance to both go back in time and catch a glimpse of the future of joint research projects in strategic fields of science. Academic authority and initiative in political and social matters, the importance of trust and multifaceted collaboration in the scientific community might be the lessons to be learnt from this event in the history of science of the XX century.

This presentation is based on work co-authored by Sergey Negrebetsky and Viacheslav Pilipenko.

Giulia RISPOLI | Sapienza Università di Roma, Italy

From the Sun to the Earth: the biosphere as a living organism in Soviet geo-ecology

As the Russian geologist Fersman claimed: «our geography is the work of ten of thousand of people participating in expeditions which have traversed our country in different directions and recorded remarkable discoveries» (Fersman, 1944, p. 38). Thanks to the presence of vast woods and uncontaminated lands, the Russian explorations were an ideal opportunity to gather a rich variety of flora and fauna; to study different structures of the soils and observe the interactive relationship between

the biological organisms and their environment. New branches of science, such as systematics, cartography, oceanography arose during the Age of Discovery, making naturalists from all over the Europe increasingly interested in visiting the Russian Academy of Science. Many years before J. Lovelock analyzed Gaia as a living system (1960), Russian scientists had already adopted an uncommon method for their investigations on the history of Earth and history of Life on Earth; treating it as an integrated subject (Graham, 1993). The unified approach to biology and geology was particularly encouraged in 1930 by the leading scientist V. I. Vernadskij, founding father of the bio-geo-chemistry, while the physician A. A. Bogdanov, precursor of cybernetics, invoked a mutual relationship among all the components of nature in his notion of the organizational process. This paper outlines the impact of the Russian naturalism and its powerful tradition upon the development of Systems Thinking in the Soviet Union. Examining three aspects in particular: how the interdisciplinary framework used by Russian naturalists partially informed the evolutionary system approach in geophysical studies during the early cold war; the leading role played by ecology in the establishment of this conception, and finally the relevance of the environmental protection movements survived during and after Stalin's regime, keeping international links beyond the Iron Curtain.

S067. Corps, santé, médecine et maladies en milieu de travail en Amérique latine, 19e et 20e siècles

Mon 22 July, 16:10–17:40 • Roscoe 1.008

Symposium organisers:

Diego ARMUS | Swarthmore College, United States
Jorge MÁRQUEZ | Universidad Nacional de Colombia, Colombia

Symposium abstract

La connaissance de la fatigue liée au travail, la quantification des risques, la prévision statistique des facteurs du stress, les imprévus d'ordre physiologique, économique ou social sont quelques-uns des problèmes développés au cours du 19e siècle par un ensemble de domaines scientifiques. Bien que pendant cette période, la préoccupation centrale de la bourgeoisie des pays occidentaux a été focalisée sur la pauvreté et, avec elle, sur la paresse et l'oisiveté, peu de réformes législatives ont favorisée les travailleurs, et celles qui l'ont fait se sont concentrées surtout sur les enfants et les femmes.

Au 20e siècle, à partir de la diffusion du taylorisme, dans ses différentes appropriations locales, sont nées et se sont consolidées la physiologie du travail, la psychologie du travail, l'hygiène industrielle et l'économie industrielle en tant que champs de la connaissance scientifique avec une préoccupation commune : la santé des travailleurs dans le contexte du travail. En outre, dans les différents pays certaines réformes sociales des années 1930 ont cherché à donner une solution politique aux conflits entre le capital et le travail.

Depuis les années 1980, des historiens de différents horizons ont étudié ce processus historique complexe de l'émergence des savoirs spécialisés dans les maladies, les accidents et la santé liés au travail. En Amérique latine, cependant, à bien des égards l'intérêt dans ce processus est très récent, et ce champ apparaît comme un nouveau domaine de recherches au sein de l'histoire générale et de l'histoire de la médecine. L'objectif de ce symposium est de réunir des chercheurs qui se penchent actuellement sur ces problèmes pour mettre à jour et partager les connaissances et pour ouvrir de nouvelles possibilités de recherche.

Chairs:

Jorge MÁRQUEZ | Universidad Nacional de Colombia, Colombia

Diego ARMUS | Swarthmore College, United States

ARAVANIS Evangelia | Universidade Luterana do Brasil (ULBRA), Brazil

Os primórdios da Legislação de Acidentes de Trabalho no Brasil (Leis do infortúnio de 1934 e 1944): um estudo dos processos de acidentes do trabalho no sul do Brasil (Rio Grande do Sul)

Nas décadas de 1930 e 1940, no Brasil, foram promulgadas duas importantes leis do infortúnio. A Lei de Acidentes nº 24.637, de 10 de julho de 1934, e a Lei nº 7036, de 10 de novembro de 1944. Estas leis davam um novo fôlego à pioneira lei de acidentes de trabalho de 1919. Dentro deste novo contexto, de um campo jurídico com maiores direitos, os trabalhadores brasileiros rapidamente perceberam a reclamação judicial como um importante caminho para fazer valer seus direitos, ingressando com ações na Justiça Comum. O presente trabalho analisa os processos de acidente de trabalho, da capital do Rio Grande do Sul, Porto Alegre, no período de transcurso da lei de 1934 à de 1944. Pretende-se expor esta arena de luta que se constituía entre os diferentes agentes sociais envolvidos e, principalmente, analisar os diálogos e embates que se estabeleciam entre os médicos legistas, as companhias de seguros e seus médicos e a Faculdade de Medicina do RS, constantemente chamada para interferir no julgamento dos processos com seus saberes, vistos como de maior relevância. Um outro objetivo do trabalho é apontar como importantes itens da lei de acidentes de 1944 passaram a ser incorporados antes desta data, a partir dos resultados destes processos trabalhistas. Para tal acontecimento observou-se que foi de significativa importância a ação e os saberes dos médicos legistas do período e da própria da Faculdade de Medicina do Rio Grande do Sul. Constituiu-se, na ocasião, local e nacionalmente, e evocando-se conhecimentos em voga em outras partes do globo, um conjunto de saberes científicos que corroboravam com as lutas dos trabalhadores e que faziam eco e evocavam o “espírito” de um novo tempo, o da era constituição da justiça do trabalho no Brasil.

The beginnings of labour accident legislation in Brazil (Misfortune Laws of 1934/1944): a study of legal proceedings related to labour accidents in the south region of Brazil, Rio Grande do Sul

In the decades of 1930/1940, two important laws related to labor accidents were promulgated in Brazil: the law nº 24.637 of July 10, 1934 and the law nº 7036 of November 10, 1944. These laws gave a new impulse to the first labor accidents law of 1919. Within this new legal context, Brazilian workers learned that legal proceedings were an important way to achieve their rights and started to appeal to Justice. This paper seeks to analyze legal proceedings related to labor accidents in Porto Alegre, the capital of Rio Grande do Sul, in the period the laws mentioned above were in course: from 1934 to 1944. I also seek to analyse the arena constituted by the conflict of interests of different groups involved in this matter, analyzing the dialogues and oppositions between legist physicians, insurance companies physicians and the Medical School of Rio Grande do Sul, which was a reference on medical knowledge. Frequently, the professors of Medical School were called to give their opinions on legal proceedings. I point out that important issues that constituted the accident law of 1944 were considered in legal proceedings even before the law was promulgated, thanks to the efforts of legist physicians as well of the faculty of Medical School. By that time, it developed in Brazil a nationwide movement inspired

in scientific knowledge that gave support to the worker's struggle for the constitution of labor justice in Brazil.

Diego ORTÚZAR | University of Buenos Aires, École des Hautes Études en Sciences Sociales, France

Médecins, appareils d'État et organismes d'assurance sociale autour de l'invalidité: Chili, 1880-1940

Médecins, appareils d'État et organismes d'assurance sociale autour de l'invalidité : Chili 1880-1940

Au cours des dernières années, la recherche historique a montré un intérêt croissant de l'analyse historique de l'administration politique des populations. A cet égard, l'étude de l'histoire des technologies médicales et du travail de la population avec un handicap a donné des importants antécédents. En essayant de contribuer dans cette recherche, la présente communication aborde trois moments centraux de l'institutionnalisation des mesures sanitaires et du travail mises en place pour faire face aux populations considérées comme improductives. D'abord, l'après-guerre du Pacifique (1879-1884) et la situation des combattants blessés et incapables de travailler. Puis, les débats des années 1920 portant sur les maladies professionnelles et les accidents du travail. Finalement, les techniques de réadaptation professionnelle développées pendant les années 1930.

Quant à l'après guerre, on abordera les débats parlementaires sur les « invalides de guerre » et les mesures d'assistance médicale et de retraite qui ont été instaurées. Puis, on verra le resurgissement de l'invalidité comme problématique associée aux revendications de sécurité au travail du mouvement ouvrier. A ce sujet, la première loi des accidents du travail (1916) et la naissance de l'assurance sociale (1924) vont être décisives pour un certain transfert des modes d'assistance des invalides vers le monde du travail. Finalement, on discutera sur les années 1930 et la consolidation des traitements de réadaptation professionnelle, époque où les nouvelles technologies médicales (prothèses, orthèse, etc.) se proposaient de rendre capable aux invalides de retourner au travail. Politique de réadaptation qui essaye de diminuer les charges économiques de l'État, mais aussi de valider la nouvelle chirurgie orthopédique et traumatologique.

Les différents moments de l'institutionnalisation des traitements de l'invalidité seront exposés à partir des archives institutionnelles, professionnelles et de la presse, en centrant l'analyse sur les conflits entre les médecins, le monde du travail et les organismes d'assurance sociale. L'hypothèse générale qui guidera cette communication est que l'invalidité fut progressivement traitée avec l'objectif de réintégration au travail, sous une politique gouvernementale, industrielle et médicale qui se proposa d'exploiter des ressources humaines auparavant considérées comme inutiles : les mutilés, les malades et les personnes âgées.

Jorge MÁRQUEZ | Universidad Nacional de Colombia, Colombia

Tuberculose et monde du travail dans les années 1930 en Colombie

Cette contribution est une première approche du problème de la tuberculose comme une maladie collective dans les années 1930 en Colombie. Elle se concentre uniquement sur les cas de tuberculose signalés par les médecins officiels pendant cette décennie dans le but d'étudier la relation entre tuberculose et monde du travail. Ce dernier était en pleine expansion dans trois secteurs: économie extractive (mines et caoutchouc); diverses plantations des produits d'exportation (banane, cacao et café); et le secteur industriel urbain. La recherche interroge aussi la relation entre, d'une part, une éventuelle épidémie ou une pandémie de tuberculose et, d'autre part, les changements démographiques associés à la croissance économique et à l'urbanisation. On interroge également le rôle des médecins dans l'objectivation qualitative et quantitative de la maladie stigmatisée

comme une maladie des classes inférieures de la société. On évalue les relations possibles entre le travail, la population et les maladies émergentes dans une jeune nation latino-américaine en pleine processus d'urbanisation et d'industrialisation.

S069. Putting the human sciences to work: managing human minds and bodies in the twentieth century

Wed 24 July, 09:00–12:30 ▪ Roscoe 2.2

Symposium organisers:

Caitjan GAINTY (non-participant) | University of Wisconsin-Milwaukee, United States

Alice WHITE | University of Kent, United Kingdom

Symposium abstract

Amidst the grand ideological struggles of the 20th century, an important and closely related series of developments was taking place: the rise of the human sciences. This symposium brings together scholars who consider not just the study of people, but also how science was applied in actively managing and influencing human behavior. Human scientists were influenced by and deeply embedded in the political and cultural debates of their time. Some sought to play a public, active role in those debates and to reshape human behavior in their ideal image, while others downplayed the applied possibilities of their research.

Panelists' case studies of specific communities demonstrate a range of interested parties who, in interacting with the human sciences, offered to 'play a key role in providing the vocabulary, the information, and the regulatory techniques for the government of individuals.' (Rose, 1996) Various individuals, organizations, and networks sought to put the human sciences to work. Public relations and propaganda practitioners attempted to use the human sciences to control beliefs or shape desires; this forms the focus of Michael Kliegl's work. Papers by Deborah Palmer and Alice White at this symposium consider the networks of industry, trades unions, scientists and medics. Caitjan Gainty will consider scientists' use of film to produce working knowledge for the US Department of Agriculture.

The symposium will consider the cultures which influenced pursuit of the human sciences. Seyma Afacan examines psychology as a tool to invent "Ottoman citizenry" within the context of modernization in the late Ottoman Empire. Across cultures, fear of revolution, be it inspired by communism or sexual liberation, as studied by Donna Drucker, inspired a desire for greater control over the population and their beliefs. Governments and businesses required ever more efficient management of workforces due to dramatic economic booms and busts. New military challenges triggered developments in psychology; Marcia Holmes discusses the impact of military doctrines upon human factors research. We will also consider the cultures inspired by the human sciences: Charlotte Sleight's study of literature explores constructions of, and responses to, employing scientific ideologies as a means to understand and govern humans.

Despite such motivations for scientific approaches to studying people, many scientists had to justify their work as valuable, expert knowledge and not just "common sense": contributors will also consider how knowledge claims were constructed in order to establish validity and construct boundaries. Our panelists' international perspectives, wide-ranging interests within the human sciences, and the variety of periods they examine within the 20th century, will provide a fascinating insight into the questions posed above.

S069-A. Governing minds and bodies with the human sciences

Wed 24 July, 09:00–10:30 ▪ Roscoe 2.2

Chair: Kira LUSSIER | University of Toronto, Canada

Alice WHITE | University of Kent, United Kingdom

Constructing consensus: human relations and the War Office Selection Boards in World War II

A crisis in British officer numbers occurred during 1941. Research identifying the reasons for the failure of officer training was conducted by a psychiatrist, and perhaps unsurprisingly identified that the human sciences could provide solutions to these problems, as a result of which the Directorate of Army Psychiatry were drafted in to assist with officer selection in experimental War Office Selection Boards in 1942. Human Scientists working in the fields of psychiatry, psychology, anthropology and sociology brought their expertise to bear on this military problem. A series of techniques including tests, exercises, and interviews, were devised as a solution.

As well as navigating scientific puzzles pertaining to officer selection, though, the scientists also had to negotiate political and cultural resistances to their authority, from the military leadership, from politicians, and from the soldiers to whom they applied their gaze. Resistance to the favouring of "the cute type of brain" vied with the view that the human science approach was "a definite asset".

This paper will consider the way in which the solutions that the human scientists devised to solve problems of officer selection were also constructed to achieve consensus and acceptance of their expertise. It will ponder how much of what occurred was through the careful and deliberate attempts by scientists to construct expertise, and how much through "sheer chance"?

Marcia HOLMES | University of Chicago, United States

Engineering the air traffic controller: the psychology of man-machine systems and the control of airspace, 1945-1958

By the end of World War II, the airplane had proven its power as an efficient transporter of goods and people, and as a devastating bringer of bombs. Thus in the postwar years, the control of airspace became an increasingly pressing concern, especially in the United States as American airlines expanded their fleets of high-speed jets, the US Air Force flew ever more sorties for surveillance and training, and in the resulting melee, horrific mid-air collisions became more frequent. Improving the nation's systems for controlling airspace naturally became a task for engineers, who extended the radar, navigation, and computing technologies developed during the war to semi-automate what had largely been a manual system of air traffic surveillance. More surprisingly perhaps, improving air traffic control was also a growing concern for psychologists, specifically those who had created the US military's procedures for selecting and training military pilots, navigators, radar operators, gunners, and other agents of air warfare. These psychologists, who called themselves "human engineers" or "engineering psychologists," had during the war insinuated themselves into the R&D laboratories of the nation's military-industrial complex by offering engineers their hard-won expertise on the psychological limitations of human operators of high-technology military equipment.

The US's emerging system of air traffic control proved to be a valuable research subject for human engineers looking to prove the mettle of their emerging field, which they, borrowing the systems language of engineers, called "man-machine systems psychology." They argued that resolving the nation's air traffic control problems would depend on how well teams of men were integrated with networks of equipment for communication, command and control; and how well these men could work as a team in such a demanding, hyper-technological environment.

To prove their point, these psychologists conducted field studies of air surveillance stations, and also elaborate laboratory-based simulations of crews performing the tasks of air traffic control. This paper will show how the problems and potentials of air traffic control shaped the psychology of man-machine systems, and in turn how this emerging field of human science hastened the implementation of the semi-automated technologies that enabled the massive expansion of American air traffic in the postwar.

Discussion

Including consideration of circulated work by Caitjan Gainty on the films *Roping Salami* (1954) and *Powers of Ten* (1968) and postwar scientific management in the US

Commentary: Kira LUSSIER | University of Toronto, Canada

S069-B. Culture and constructing citizens with the human sciences

Wed 24 July, 11:00–12:30 ▪ Roscoe 2.2

Chair: Rhodri HAYWARD | Queen Mary, University of London, United Kingdom

Michael KIEGL | University of Kent, Germany

A new democracy: public relations and the human sciences as a means for managing the population in 1920s and 1930s USA

Alarmed by the horrors of the First World War, the Russian Revolution, and the rise of fascism and totalitarian regimes in Europe, the interwar years in the USA were marked by a heated political discourse about the nature of people and their role in politics and society. To many, these wars and revolutions revealed what inhumane and irrational actions people could be capable of when acting in large groups. Influenced by Freudian notions of irrational unconscious drives and theories advanced by the likes of Walter Lippman and Gustave LeBon about crowd psychology, political and business leaders feared that the collective human mind presented a fundamental threat to the health of American democracy. And so they sought the means to control it.

Spearheaded by its two founders, Edward Bernays and Ivy Lee, the newly established field of public relations claimed that it had exactly these means. As they explained it, they would use the full sophistication of science, and put it into practice to help businesses and politicians to promote both themselves and their ideologies. From psychoanalysis and behavioural psychology to sociology and the advent of modern polling techniques, PR practitioners were eager to use the full range of the human sciences to study the population and thereby to devise the techniques to manipulate it. And in the process, they would also create a new political ideology, wherein a society built around consumerism would keep the people happy and the intellectual elites would guide the masses in their decisions.

Seyma AFACAN | University of Oxford, United Kingdom

Discourses on the soul and emotions in the late Ottoman Empire: reactions to the mechanistic view of human nature and the concept of mind training

During the 'long' nineteenth century in the Ottoman Empire, particularly the Second Constitutional Era (1908 – 1918), Ottoman intellectuals articulated a variety of ideas on the definition, nature, and use of psychology parallel with the transformations in cultural, political and social milieu. As Ottoman intellectuals envisioned a comprehensive social transformation, and discussed the limits of modernization as well as the role of religion in a future society, the components of human

nature remained controversial. So did the use and nature of psychology. The opposition between materialism and spiritualism, mechanistic view of human nature as well as the approaches towards emotions and soul constituted the backbones of the controversy. This paper is concerned with the discourses on mechanistic view of human nature and mind training in the Ottoman Empire from 1908 to 1923. Broadly it aims to gain an insight into the relationship between science and religion within the context of Ottoman modernization. In order to do that, it will study the conflict and the midways between materialism and spiritualism via early books and journal articles on psychology which enriched the discussions on human nature. It will discuss the questions as to what extent the emphasis on mechanistic view of human nature can be seen as an attempt at managing human minds and to what extent the literature on the soul and emotions can be seen as a critique to top-down modernization.

Anne GOSSOT | Université Bordeaux 3 & UMR 8155, France

La méthode du triangle de Toyoda Junji ou la constitution de l'ergonomie physique moderne au Japon 1918-1950

En Occident comme au Japon, les historiens des techniques situent généralement la naissance de l'ergonomie après la seconde guerre mondiale. C'est vrai de l'ergonomie organisationnelle. Mais l'ergonomie physique ou « ergonomie de produit » semble plus ancienne. En tant que « science de l'adaptation physique des objets », l'« ergonomie de produit » apparaît au plus tard dans la 2^{de} moitié du XIX^e. Au Japon, elle semble se constituer prioritairement dans le secteur industriel du mobilier scolaire. Un temps alignée sur les méthodes anthropométriques élaborées en Occident, elle élabore ses propres outils à partir de la fin de la 1^{ère} guerre mondiale. Un médecin scolaire des écoles publiques de Kyôto, Toyoda Junji, semble en être le premier inventeur. Nous présenterons sa méthode en éclairant la nature de leur apport historique, à partir des sources originales en langue japonaise. Notre propos est ici de discuter la méthode du Dr Toyoda pour en tester l'originalité et, ce faisant, repenser le mode de constitution historique de l'ergonomie japonaise.

S070. Transferring and forming pharmaceutical knowledge: from practical work to academic disciplines and back, from the seventeenth to twenty-first centuries

Thu 25 July, 09:00–12:30 ▪ Roscoe 1.007

Symposium organisers:

Stuart ANDERSON | London School of Hygiene & Tropical Medicine, United Kingdom

Bettina WAHRIG | Technische Universität Braunschweig, Germany

Symposium abstract

Well into the 19th century, pharmaceutical knowledge belonged to the realm of craftsmanship. It was generally classified as practical rather than scientific knowledge. It developed into an academic discipline only gradually. When pharmacists were finally able to study and teach at universities or at academies or schools, the sciences were generally orienting themselves towards experimental and practical knowledge. Today, pharmacy is regarded as an interdisciplinary and applied science

with a number of sub-disciplines linking pharmacy to botany, medicine, chemistry and other sciences.

Knowledge about medicinal substances has been contested over many centuries, and in different perspectives. Academic physicians, pharmacists, botanists and chemists, along with members of other professions, struggled over the access to pharmaceutical knowledge, and over the legitimation to produce and administer drugs. Especially in the late 18th and early 19th centuries, the professions fought over legal regulations of the drug market, and tried to enforce the exclusion of lay persons, quacks and interlopers, thereby trying to corroborate their own professional identities.

Yet, the discourses were by no means only about the exclusion of untrained practitioners. The many adjoining fields of knowledge opened up possibilities of communicating and transferring knowledge across disciplines, across regions and across cultures. The trade with medicinal substances from the New World or from China or India, for example, had an impact both on European knowledge systems and on the local and regional agricultures. In Early Modern Europe, exotic drugs started out as highly effective, costly and therefore exclusive medicines, but in the 19th century, they became objects of investigation for analytical chemistry and experimental physiology.

Many plants from the New World were transferred to Asia; they were cultivated extensively, often devastating the agricultural equilibrium and sometimes even provoking wars. They were transformed into medicinal substances and exported to Europe on a large scale.

The papers of this symposium will focus on the transfer of pharmaceutical knowledge across time and space in the following areas:

- from therapeutic practice to clinical and physiological concepts;
- from one geographical region to another;
- from the laboratory to the clinic;
- from natural history to pharmacology and toxicology;
- within networks of trade and knowledge.

The papers will analyse medicinal substances within a wide range of topics, namely the practice of colonisation, the fields of traditional, new and contested pharmaceutical knowledge within a network of communication, classification and boundary objects as means of knowledge transfer, synthetic drugs, and the transfer from the laboratory to the clinic and back.

S070-A. Documenting pharmaceutical knowledge

Thu 25 July, 09:00–10:30 • Roscoe 1.007

Chair: Stuart ANDERSON | London School of Hygiene & Tropical Medicine, United Kingdom

Bettina WAHRIG | Technische Universität Braunschweig, Germany

Boundary objects: German systems of pharmaceutical substances in the eighteenth and nineteenth centuries

In the late 18th century, modern *materia medica* began to take new forms. It began to lead a life independent of the traditional pharmacopeas. The market for books describing pharmaceutical substances, their preparations and their use, diversified. Physicians needed handy instructions for effective prescriptions; and they also valued the works of those colleagues who revealed their most valued secret recipes towards the end of their life. The tradition of pharmacopeas authored by physicians was continued, especially if the authors were town physicians or aspired such a position.

From the beginning of the 19th century, works titled '*materia medica*' (*Arzneimittellehre*) were also published to promote a specific therapeutic orientation, e.g. *materia medica* for physicians oriented towards natural philosophy. During the same time period, the knowledge about medicinal substances began to emancipate itself from natural history, and a number of intersections between experimental physiology, experimental pathology, and toxicology were created. In this period, the sub-discipline of pharmacology took form. Textbooks informing physicians about how and why to use which pharmaceutical substance then started to bear the word "pharmacology" in their titles.

While traditional *materia medica* books continued to rely on the traditional system of the three realms (mineral, vegetable and animal substances) and in addition often on the distinction between *simplicia* and *composita* (i.e. simple and composite remedies), other authors referred to new chemical and therapeutical concepts and started out to inscribe the new order of chemistry or novel concepts of the living body into their systems. From the middle of the 19th century onwards, experimental accounts of pharmacology began to affect the writing of textbooks, and a new divide arose between textbooks that merely described pharmaceutical substances, and those that centred around the experimentally produced pharmacological effects.

One intriguing finding is that German *materia medica* heavily relied on the works written by other European authors - especially from England and Scotland. I will also discuss why the classification of medicinal substances was often similar to systems of toxicology.

Viola BALZ | Evangelische Hochschule Dresden, Germany

The emergence of a new concept of effectiveness documentation systems and psycho-pharmaceuticals in West and East Germany, 1955-1985

The aim of the talk is to focus on the development of new documentation systems, that created a new understanding of the efficacy of psychotropic drugs.

The fact that the particular effectiveness of psycho-pharmaceuticals only became visible with clinical trials in patients moreover posed a challenge to their evaluation. The psychotropic effects to be observed, however, are conveyed through the subjectiveness of the patients and only become accessible for the clinicians in their comments.

I am going to illustrate that generating a solid concept of effectiveness for psycho-pharmaceuticals was only possible due to new clinical recording systems. Said development of new recording systems took place within the scope of adjusting the conditions of a »clinical experiment«, as I refer to the introduction to a controlled clinical trial. However, without intending to conduct a detailed analysis of this process here, I would like to outline the emergence of a new recording system that allows a new concept of effectiveness to materialise. Object of investigation will be the local development of such systems, which entailed extensive semantic changes in the concept of effectiveness.

Using the example of debates in West and East Germany, I will describe the similarities and differences in effectiveness assessment of the two states. In doing so, the discussions eventually shifted from local discussions among different schools within the states to the national level of *Systemkonkurrenz*, that is, East-West competition. A competition that was in particular interesting for the development in East Germany, since West German researchers hardly ever referred to the GDR.

At first I will delineate the debates of the young West German republic, which finally led to the development of the AMP system. In the second part of the talk I will depict how the standardisation of psycho-pharmaceutical effects was discussed in East Germany, and which positions were confronting each other. Finally I will outline the introduction of the AMP system and its further development in the late GDR. In the third part I am going to elaborate, how the new assessment logic of the AMP system and its East German extension, the Structured Psychopathological Assessment System (*Strukturiertes*

Psychopathologisches Erfassungssystem, SPES), changed the knowledge of psychotropic effects.

Ariane RETZAR | Philipps-Universität Marburg, Germany

Documentation and assessment of adverse drug reactions (ADR) in the former German Democratic Republic (GDR)

It was in 1969 that side effects ought to be reported to the 'Institut für Arzneimittelwesen' (IfAr) in Berlin. Therefore, a special blank was provided. The reports arriving were collected and evaluated by the IfAr. Although the number of incoming reports had initially been increasing, the overall willingness to report ADR must be characterized as relatively moderate. As a consequence, public appeals were placed in several medical and pharmaceutical journals in order to call attention to this problem. Nevertheless, these and other measures such as an obligation to report, which was established in 1981, did not succeed. Under the circumstances, decisions on withdrawal of drugs or other restrictive measures were in many cases made with consideration of international experience.

A crucial board deliberating on adverse drug reactions was the 'Zentraler Gutachterausschuss für Arzneimittelverkehr' (ZGA) which was already officially legitimized in 1949 when a directive came into force regulating the circulation of medicinal products. Members of the ZGA were clinicians, pharmacologists, pharmacists and also representatives from industry. Among other things, their essential function consisted in counselling the Ministry of Health regarding decisions on the registration or deletion of drugs.

In the second half of the 1970ies occurrences of lactic acidosis increased on the therapy with biguanides, buformin and phenformin in particular. This led to discussions about the safety of these kind of drugs – also in the GDR where reports of lactic acidosis have not existed until October 1977. For instance considering this affair, the ZGA was asked to make a statement. On the contrary, Arupex liquidum®, a drug against head louses, is an example for a modified benefit-risk assessment based on ADR reports having arrived at the IfAr.

Nils KESSEL | Université de Strasbourg, France

How do doctors prescribe, what do pharmacies sell? IMS health and pharmaceutical market research as tools for market construction and health policies

Since the 1950s, an American company named IMS developed specialised market research for pharmaceutical companies. By quantifying global drug sales on both regional and national levels IMS offered an important tool to major drug companies' marketing strategies. From then on, it was possible to know the approximate market size of each therapeutic group, each subgroup and even of each dosage form of a product and its competitors. Combined with information on prescription habits and physicians' diagnostic choices, these new computer-based projections promised to make drug markets manageable. These new knowledge technologies gave pharmaceutical companies an important advantage over health insurance or regulatory bodies that did not have access to these numbers. In my contribution I present IMS Health's market research tools and the results they produced. IMS Health's story will be embedded in a larger history of drug costs and consumption. Based on IMS Health's archival documents I will show how knowledge on drug markets became indispensable for pharmaceutical markets and health policies.

S070-B. Transferring pharmaceutical knowledge

Thu 25 July, 11:00–12:30 ▪ Roscoe 1.007

Chair: Bettina WAHRIG | Technische Universität Braunschweig, Germany

Stuart ANDERSON | London School of Hygiene & Tropical Medicine, United Kingdom

Spreading pharmaceutical knowledge: 'the rejection of tradition in favour of experience:' the popularity of British pharmaceutical texts in the seventeenth and eighteenth centuries

During the seventeenth and eighteenth centuries British pharmaceutical texts achieved a popularity and influence that extended far beyond the shores of the British Isles. They contributed to the spread of pharmaceutical knowledge across Europe, Asia, America and Africa. How was this influence achieved, and how was it sustained? This paper explores the reasons why British pharmaceutical literature came to be so influential throughout the world during this period.

Although there were several categories of pharmaceutical literature the key ones were the official pharmacopoeias; between the early seventeenth and mid-nineteenth centuries there were three; the London Pharmacopoeia (first edition 1618, last 1851), the Edinburgh Pharmacopoeia (first 1699, last 1841) and the Dublin Pharmacopoeia (first 1807, last 1856). All were reproduced abroad, although they were often edited, corrected or augmented.

Altogether there were 47 foreign issues of the London Pharmacopoeia, 27 of the Edinburgh Pharmacopoeia, and one of the Dublin Pharmacopoeia; the earliest was a translation of the London Pharmacopoeia published in Leyden in 1677. They were translated into many languages and printed in 25 cities in 10 countries, from Boston in the US to Antananarivo in Madagascar.

British works were widely acknowledged for their 'enlightened approach', their 'great discernment' and their 'rejection of tradition in favour of experience.' Their simplicity and brevity were also much praised. They were extolled for their neat layout and conspectuses, which combined material from several pharmacopoeias, were considered especially useful. The works were the result of the collective efforts of distinguished physicians of Royal Colleges and this added to their prestige.

Indeed, the pharmacopoeias were developed in Britain with a reforming zeal that eliminated superfluous items, and the compilers had the courage to erase such established products as theriac. New medical knowledge and new medicines were incorporated, the new chemistry was taken into account, and the nomenclature of Linne was introduced.

It is concluded that the influence of British pharmaceutical texts can be attributed to three main factors; the normal processes of cultural diffusion; the intrinsic quality of the British product (people trusted the information provided); and the fact that it met a need abroad. Above all the popularity of British pharmacopoeial literature reflected Britain's leadership in pharmacopoeial reform.

Ursula LANG | Philipps-Universität Marburg, Germany

Combating rot and smell: guiding theme for implementation of antiseptic substances in the eighteenth and nineteenth centuries

The "antiseptic" practice in the meaning of "antibacterial" started with the search of means against rot and putrid smell. In former times people believed that miasma or foul air caused epidemics. Hence corrupt air had to be cleaned by use of "anti-miasmatic" substances. The burning of incense and aromatic wood and the sniffing at scented perfume balls served as defense strategy against infectious diseases. Between 1750 and 1752 the Scottish physician John Pringle (1707–1782) reported about his accomplished "Experiments upon Septic and Antiseptic substances" at the Royal Society and characterized materials like acids and aromatic herbal extracts that measurably decelerated or stopped the putridity of flesh as "anti-septic". *Acetum anti-septicum vulgò des Quatre Voleurs* (Codex medicamentarius Parisiensis, 1758) evolved into a

favoured remedy to keep off the plague and other epidemics. People sniffed at this aromatic vinegar, washed hands and sprayed it on clothes to protect themselves against the contagion. The next major step in the search for antiseptic substances was the progress in the treatment of corpses against decomposition. The preservation of corpses without corruption and pestilent stench was essential for anatomic and forensic examinations. The French pharmacist Antoine Germain Labarraque (1777–1850) experienced in the 1820s with alkaline solutions of sodium hypochlorite and chloride of lime. *Labarraque's solution* was poured over corpses in the mortuary of Paris, and moreover it was used against putrescent wounds as well. The French chemist Jean Nicolas Gannal (1791–1852) discovered the astringent salts Aluminium chloride and Aluminium acetate for the nonhazardous preservation of corpses in the year 1835. The German surgeon Karl Heinrich Burow (1809–1874) reported in 1857 that he irrigated and deodorized putrid wounds with an Aluminium acetate preparation which became known as *Burow's solution*. After Louis Pasteur (1822–1895) had realized the participation of microorganisms in fermentations and putrefaction in the 1860s the germ theory of infectious diseases induced an essential change in the implementation of aseptic strategies. In times of increasing bacterial resistance against antibiotics the knowledge of topical mild antiseptics like acetic acid and Aluminium acetate solution should be prevented from falling into oblivion.

This presentation is based on work co-authored by Sabine Anagnostou.

Silvia MICHELETTI | Technische Universität Braunschweig, Germany

Exotic poisons, beheaded dogs, and resurrections of donkeys: physiological experiments with curare from the exotic scene to the laboratory-theatre

This paper will analyze some aspects of the investigation of the South American arrow poison curare in the field of experimental physiology in the early 19th century. Through the analysis of the experimental work of two British scientists, Benjamin Collin Brodie and Charles Waterton, it will be shown how the inquiry about curare, its characteristics and its effects at that time involved a range of interdisciplinary matters, like physiology, analytical chemistry and practical medicine. At the same time, dealing with the poison as an exotic object aroused other questions which have to be investigated within the practice of colonisation as well the network of communication between European scholars and between Europe and the New World.

Especially the work of the naturalist and explorer Charles Waterton, his book *Wandering in South America* and as his later physiological experiments in England, furnish a powerful example of how colonial practices, racist stereotypes, experimental practices and exchange of knowledge, as well as the great influence of the Royal Society of London, all converged in the scientific investigation of curare during the early 19th century.

Finally, Brodie's and Waterton's attempt to save poisoned laboratory animals through artificial respiration, and their new struggle to find medical applications of curare (especially in the treatment of tetanus), will show the gradual transformation of a poison, which had earlier being defined as work of the devil and carrier of death, into a substance which may save life; a transformation which accompanies the journey of curare from the rain forest to the European laboratory.

Axel HELMSTÄDTER | Goethe University Frankfurt, Germany

Pharmaceutical knowledge transfer from Germany to Britain (and back)

In the 1840s, professionalization of pharmacy in Great Britain made significant steps forward, so in 1841 the Pharmaceutical Society of Great Britain was founded, followed by university education in 1842. A significant number of early pharmaceutical leaders had received training in Germany, particularly in Justus Liebig's Laboratory in Gießen. Among

those was George Fownes (1815-1849) who visited Gießen between 1837 and 1839. He was appointed the first professor of chemistry at the School of Pharmacy in 1842. John Llooyd Bullock who was in Gießen in 1842 was one of the founding members of the Pharmaceutical Society. We may assume that Gießen visitors influenced the Society to establish a laboratory for teaching chemistry. Opened in 1844 it was one of the firsts of its kind in Britain. Liebig himself inspected the venue during a stay in London. Edward Frankland (1825-1899) who started his career in pharmacy and later became professor of chemistry in Manchester came to Germany and received his PhD at the University of Marburg. Germany was still regarded a place worth to be visited for studies so William Martindale (1840-1904) sent his son, William Harrison Martindale (1874-1933) to Marburg for doing his PhD thesis. The first major British pharmaceutical textbook, Theophilus Redwoods "Practical Pharmacy", edited in 1849, was translated from the German "Lehrbuch der Pharmaceutischen Technik, written by Carl-Friedrich Mohr (1806-1879) later working at the University of Bonn. The translator, however, made several changes to meet the particular needs of the British pharmaceutical chemist. Redwood also had connections to Liebig as shown in a written correspondence about the conservation of meat.

In the 20th century clinical pharmacy services developed much faster in the UK than in Germany. British hospital pharmacists helped a lot in establishing continuing education programs particularly in the 1980's and 1990's. This may serve as a late example of knowledge transfer as well – in the opposite direction than in the 19th century.

S071. The science of man? Bounds of knowledge in the twentieth century

Wed 24 July, 14:00–17:30 ▪ Roscoe 2.2

Symposium organisers:

Graham BAKER | University of Oxford, United Kingdom
Erika DYCK (non-participant) | University of Saskatchewan, Canada

Symposium abstract

The scientific study of humankind progressed at a phenomenal rate during the twentieth century. From the 'rediscovery' of Mendel's laws of heredity through to the completion of the Human Genome Project, the work of scientists was recognised, on a global scale, to have an intrinsic significance to human life. This was seen in international collaborative projects, endeavours which even succeeded in rising above the political tensions of the Cold War.

The effort to gather this knowledge and apply it to human life encompassed methods that ranged from the benign to the barbaric. The eugenics movement is often associated with the latter, with good reason, but there have been fewer studies of the response that this movement received from the groups that were marginalised under its ideology. This is a particularly significant issue owing to historians' recognition that eugenics emerged with the creation of modern nation states, and the desire of these states to supervise the 'national body'. In this symposium we seek to bring together scholars working on the following questions, with a focus upon eugenics and other knowledge systems that intended to use science to categorise and regulate humanity:

What evidence is there of lay communities guiding the direction and shaping the form of knowledge that was supposed to be the preserve of experts and a scientific elite?

How was the eugenics movement shaped by the work of academics and professionals working in other disciplines? What concerns dictated the

practical research and work of those individuals working under the umbrella of eugenic ideas?

How were these technological, medical, and scientific advances translated into the everyday lives of lay people?

How was scientific, medical, and technological knowledge, received or resisted within the communities that were supposed to have been marginalised by it?

To what extent do these considerations open up the question of a marketplace for eugenic ideas, with the public as 'consumers' of science, technology, and medicine, and what were the implications of this environment for the advancement of research agendas through scientific funding bodies and philanthropists?

How was eugenic science woven into progressive politics, and how then, did social and political groups mobilise efforts to support or denounce eugenics?

S071-A

Wed 24 July, 14:00–15:30 ▪ Roscoe 2.2

Chair: Graham BAKER | University of Oxford, United Kingdom

Elise SMITH | University of Oxford, United Kingdom

Biometrika and the statistical reinvention of British racial science, 1901-1930

At the start of the twentieth century, the dilettantish Victorian approach to racial science came under attack by a new generation of anthropologists who favoured standardised investigative techniques allied to modern modes of mathematical analysis. Statisticians such as Francis Galton and Karl Pearson insisted that the only legitimate form of racial research was that informed by the most advanced statistical methods. The vehicle of Pearson's new 'biometrical' school in London was the journal *Biometrika*, launched in 1901 to promote this new vision of modern racial research. Bluntly rejecting the work of nineteenth-century anthropologists, *Biometrika* not only advocated a more rigorous method of evaluating population differences, but also lampooned traditional approaches from a 'mathematico-statistical' standpoint. The biometrical school explicitly reformed Victorian methods of racial research, such as craniology, to inform a statistically-driven model of human evolution that tracked diversity within and between racial groups. However, their new brand of racial science shared many of the assumptions of earlier practitioners who assumed a link between physical and mental development, and who advanced a prejudiced agenda that emphasised differences over similarities. While claiming that their new form of statistical research was more 'objective' than that of their predecessors, *Biometrika* revealed that underlying attitudes towards race remained static in spite of the methodological shift its founders heralded.

Amy SAMSON | University of Saskatchewan, Canada

Complicating eugenics: gendered occupations and eugenic sterilization in Alberta, Canada

On March 21st, 1928 the United Farmers of Alberta government passed the Sexual Sterilization Act. The eugenic legislation remained in effect until 1972 and resulted in the sterilization of more individuals considered "mentally defective" than any other jurisdiction in Canada. Until recently, scholarship on the legislation has largely focused on identifying the "targets" of the eugenic program through statistical analysis of the provincial Eugenics Board case files. These sociological and legal studies have demonstrated that certain segments of the population, including women, were disproportionately sterilized in Alberta. Women, as "mothers of the race," were central to eugenic thought, however, depicting them as simply "targets" of sterilization neglects the gendered occupations that served on the program's frontline. Progressive politics and the medicalization of "social problems" the turn of the twentieth

century engaged new levels of professionals, including nurses and social workers, in a more comprehensive matrix of surveillance over those people and families determined "mentally defective," or "unfit." Drawing on the records of Alberta Department of Public Health, professional journals, and other archival material, this paper will complicate the narrative of male medical professionals, and a few women in positions of political influence, exercising control over the reproductive rights of predominately female patients that has largely dominated the history of eugenics in Alberta. It will argue that leaders within nursing and social work framed their respective occupations within the socially and scientifically significant eugenics movement as a way to maintain and extend their occupational authority.

Molly LADD-TAYLOR | York University, Canada

Data of degeneracy: eugenics field research and institutional power in the US Midwest

Many volumes have been written about the family pedigree studies produced by the Eugenic Record Office (ERO) in Cold Spring Harbor, N.Y., but little attention has been paid to the everyday process and purpose of eugenics field research. This paper focuses on the production of one of the ERO's last family studies, *Dwellers in the Vale of Siddem* (1919), by A.C. Rogers and Maud Merrill, to explore the creation of eugenic knowledge and the growing power of state institutions in the emerging welfare state. The first half of the paper draws on the correspondence and reports of two female field researchers who were paid by the ERO but supervised by Rogers, the superintendent of the Minnesota School for the Feeble-minded. It explores how the conflicting viewpoints of county officials, neighbours, and eugenicists were shaped into a single story of feeble-mindedness and degeneracy, and considers how some local officials may have used eugenics field research to deal with families they saw as an economic and social burden. Eugenics field research functioned as a kind of institutional extension work, at least in rural Minnesota. It strengthened the relationships between county officials and the state institution and paved the way for a compulsory institutionalization law. The paper then turns to the book itself, comparing the researchers' field notes to the published text and commenting on the inconsistencies. *Dwellers in the Vale of Siddem* was published two years after Rogers died, and it is considered insubstantial even by the standards of ERO family studies. Yet if the book itself had little value as research or propaganda, the process of eugenics research was important. It extended the institution's influence and disciplinary power into remote communities and lay the foundation for the state's eugenic sterilization law.

S071-B

Wed 24 July, 16:00–17:30 ▪ Roscoe 2.2

Chair: Molly LADD-TAYLOR | York University, Canada

Bradley W. HART | California State University, Fresno, United States

The marketplace of eugenic ideas, transnational organizations, and the role of philanthropy

Throughout the first decades of the 20th century, eugenic ideas gained and enjoyed a substantial following in both academic and non-- academic circles around the globe. While many of the most prominent spokespeople for eugenics were scientific or medical practitioners, a substantial number of lay activists and enthusiasts also made significant contributions to the movement. These latter figures often found it easiest to exert influence in international organizations dedicated to the political campaign for eugenic social reform, and consequently most of the major groups most closely associated with the eugenics movement were actually headed or at least partially led by amateur enthusiasts through the 1920s and 1930s. Further, many of these non-- scientists initially gained their influence through significant financial contributions to scientific researchers working on eugenic studies and the same activist

organizations they were leading. This paper will 'follow the money' and examine the financial underpinnings of the international eugenics movement in the first four decades of the 20th century to explore the influence of outside philanthropy on the development of eugenic science and social reform campaigns alike. The first major donor to the eugenics movement was Francis Galton himself, who endowed University College London's eugenics chair in his will. Over the following decades a number of significant individuals from both the U.S. and Great Britain followed in Galton's footsteps, making substantial personal contributions to research they believed would advance the cause of eugenic social reforms. Interestingly, several of these figures saw themselves as amateur researchers who had been excluded from the scientific establishment through the processes of academic professionalization that took place during the same period. It is clear that through financial contributions these figures hoped to secure themselves a role in determining the path eugenics would take despite their lack of academic qualifications. Finally, this paper will conclude by examining the responses of the scientific practitioners who received such funds to the efforts of their donors to direct research priorities from afar to argue that eugenics was always a contested terrain between scientific and non- scientific voices.

Lesley A. HALL | Wellcome Library, United Kingdom

Send in the clones? Naomi Mitchison, feminism, socialism, eugenics, and science fiction

Angus McLaren in his recent study *Reproduction by Design: Sex, Robots, Trees, and Test-tube Babies in Interwar Britain* (University of Chicago Press, 2012) has delineated the extent to which issues about reproduction, fertility and breeding were being expressed and debated between the wars in Britain. Naomi Mitchison (1897-1999) was positioned centrally within the flux of these ideas: her brother was the Communist geneticist and populariser of science JBS Haldane, while his wife, Charlotte, wrote both dystopic fiction and a polemic on modern motherhood; Aldous and Julian Huxley were close family friends. She was active in the birth control movement and a somewhat conflicted member of the Eugenics Society, as well as part of the feminist circle around the journal *Time and Tide* and involved in Labour politics, supporting her husband as he pursued election as a Labour MP. A prolific and successful novelist, in the 1960s she turned to writing science fiction in which she presented a number of issues around breeding and reproduction, engaging in a nuanced dialogue with ideas that had proliferated in the earlier part of the century in the milieu in which she was embedded, by no means entirely superseded at the time she was writing. Her science fiction novels ask intriguing and pertinent questions about a range of issues, as, from a possibly unique perspective, she explored ideas generated by intersections between a wide range of theories, beliefs and ideologies, from Edwardian feminist eugenics of free mate choice, via interwar eugenics, to the implications of Watson and Crick's discovery of DNA.

Graham BAKER | University of Oxford, United Kingdom

'Public-spirited co-operation': Julian Huxley, eugenics and popular education

Sir Julian Huxley, grandson of 'Darwin's bulldog' T. H. Huxley, was one of the most prominent scientists and 'public intellectuals' of the twentieth century. He held academic positions in Britain and the USA, after which he served as the Secretary of the Zoological Society, London, and as the first Director-General of UNESCO. Huxley campaigned for issues including birth control, population restriction, conservation, scientific humanism, and eugenics. In this paper I will analyse Huxley's involvement with the propaganda film 'Heredity in Man', a work which was produced by the Eugenics Education Society in the 1930s. I will outline the production of this film, the debates that shaped its contents, and compare the work to the broader reputation of Huxley as a populariser of science. I will place this within the context of eugenics

education and propaganda work in the UK, and the historiography concerning reform and mainline eugenics.

S072. Preserving scientific heritage to enable working with knowledge: how historians, archivists and scientists can engage in preserving and disseminating scientific heritage via a global online system

Mon 22 July, 11:00–17:30 ▪ Uni Place 1.218

Symposium organisers:

Joe ANDERSON | American Institute of Physics, United States
Anne BARRETT | Imperial College London, United Kingdom

Symposium abstract

This symposium will seek to develop momentum in the preservation, access and dissemination of scientific heritage by engaging the key players in this mission through collaborative working. Preservation and dissemination of scientific heritage is vital for present and continued study of 'scientists at work'. Collaborative working is the key to placing preservation and dissemination of scientific heritage on a sure footing.

Archivists/information specialists and historians of science and technology share a common investment and interest in the sources that document this field. We can capitalise on this by optimizing opportunities for creating an agenda of joint working between archivists/information specialists and historians to identify, preserve and make accessible papers of scientists on a global scale; streamlining catalogue access via an online web hub and use of Linked Data to enrich the content, and display connections not previously obvious, and by collaborating with current projects such as AIM25 and WHSO. Thereby raising the profile of scientific heritage and facilitating historians work by the enhanced online union catalogue approach.

Colleagues in the United States, Europe and Australia are keen to develop this dialogue via their symposium papers, to demonstrate how their expertise can be integrated in the common cause.

Case studies will serve to demonstrate the scientific heritage and how it can be used creatively. They will show the different ways scientists, live, work and preserve records of their activities, how their records can be used for different purposes than those originally created for, their relationship between work and science, insights into the engagement and influence of scientists with government, industry and the public.

International approaches to the preservation of scientists papers, to scientific heritage as an important part of history as a global whole, attitudes to funding and support, and importantly the place of a union catalogue website, will be explored as essential elements in the mission of preserving and disseminating scientific heritage, all contributing to knowledge at work.

S072-A

Mon 22 July, 11:00–12:30 ▪ Uni Place 1.218

Chair: Joe ANDERSON | American Institute of Physics, United States

Jean DEKEN | SLAC National Accelerator Laboratory, United States

Historians at work in the SLAC archives: an archivist's perspective

Active collecting of the archives of the SLAC National Accelerator Laboratory – as well as of other US national laboratories—began in earnest in the late twentieth century as a result of the interest of and agitation by both Historians of Science and Archivists. This paper examines the use and dissemination of knowledge of the histories of the US science laboratories as exemplified by the SLAC Archives and History Office (AHO) experience. We find that the development of the SLAC AHO program has been and continues to be propelled by ongoing exchanges between the two disciplines, shaped by their sometimes limited understanding of each other's goals, methodologies and constraints, and by the two disciplines' relationships to the records-creating scientists

Greg GOOD | American Institute of Physics, United States

How historians come to the islands of kept documents, and what they experience when they arrive

Historians come to archives with mixed backgrounds and expectations. Many are new to archival research and, due to the vagaries of personal experiences, may come with hope, expectation, even uncertainty or disdain or awe. Others are old hands and, due to the vagaries of personal experiences, may come with hope, expectation, even uncertainty or disdain or awe. Historians and archivists both need to focus on how we use and disseminate the knowledge found there. We need to consider how we work with archived knowledge, especially now that so much more is becoming so much more readily available. In this paper, I present one historians views on working with archived knowledge we act as intermediaries in its dissemination.

Peter COLLINS | Royal Society, United Kingdom

Experiences in the historical scientific world

This paper will explore the world of historical science and the sense that is made of it today, from the perspective of a chemist turned science policy expert and latterly historian of science

Karl GRANDIN | Royal Swedish Academy of Sciences, Sweden

Possible at the Center? Experiences from the design of a research program

The Center for History of Science at the Royal Swedish Academy of Sciences is an infrastructure organisation that runs the Academy archives, including personal archives and the Academy's Nobel archives as well as a collection of scientific instruments and an observatory museum. We have recently designed a – by our standards – large program with the overall goal to strengthen the history of science community in Sweden. The research program – Science and modernization in Sweden: An institutional approach to historicizing the knowledge society – has been funded and it is centred on the history of the Swedish Academy of Sciences. The program will be coordinated from the Center, but the research will be done mostly at the universities. The presentation discuss how the interaction between the historians and the archivists did (or did not) play a role in the design of the final program.

S072-B. Sharing knowledge in context: linked data and online technologies in scientific archives

Mon 22 July, 14:00–15:30 • Uni Place 1.218

Chair: Gavan MCCARTHY | University of Melbourne, Australia

Ailie SMITH | The University of Melbourne, Australia

Helen MORGAN | The University of Melbourne, Australia

Sharing knowledge in context: linking the *Encyclopedia of Australian Science* into global online resources

Many institutions hold collections of archives and other materials that document the history of science, technology, engineering and medicine. Online technologies have enabled information about these collections – and in some cases the collections themselves – to be made available widely for research. However often these efforts result in disconnected silos of information that are difficult to find and lack the depth that they could have if they were connected to other resources.

The *Encyclopedia of Australia Science* is an online register that seeks to bring these resources together in the Australian context, documenting Australian scientists and scientific organisations through evidence found in archives and records, along with an in-depth bibliography of the history of Australian science. However many Australian scientists have had global careers, and developments in Australia have influenced or been influenced by the global scientific community, so there are broader linkages that can be made.

This paper will explore the need for research infrastructure and services for the description and contextualisation of history of science, technology, engineering, and medicine resources at multiple levels, ranging from organisational, through national, to international networks of linked data. Rather than replicating the localised and fragmented documentation that existed in the pre-digital world, online resources enable the creation of rich networks of contextual information linking resources from multiple locations together in ways that can create new ways of interpreting or understanding the material.

Geoff BROWELL | King's College London, United Kingdom

Linked data in science archives: the AIM25 experience

AIM25 is a major aggregation website that collects descriptions of archives held in the London area from more than 130 educational, scientific and other organisations and attracts more than a million hits a month. Contributing institutions include the Royal Institution, Royal Society and Wellcome Library. A recent project has highlighted the value of using Linked Open Data to improve access to these valuable collections still further. The project also highlights the potential value of Linked Data to map datasets relating to the history of science and combine information about people, places and subjects. This talk will describe the AIM25 experience and summarise some of the important work being carried out in this area.

Neil FORBES | Coventry University, United Kingdom

New connections: the BT e-Archive project

Coventry University, in partnership with BT plc and The National Archives was awarded a major grant by JISC to create a digitised online version of BT's physical archive, containing much of the information currently held in London. The project is cataloguing, digitising and developing a searchable online archive of almost half a million photographs, documents and correspondence preserved by BT and predecessors over the last 165 years.

It is possible to argue that the modern age has been shaped by telecommunications; it is the history of Britain's leading role in the development of this science and technology and its impact on society that is contained in the internationally-important BT Archives. The significance of the collection is immense in its scope both in the period covered and in its range of subjects: technical reports and other documentation reveal, for example, the development of telegraphic

transmission, telephonic communication, optic fibre networks and computerisation.

The need to open up access to existing and newly-created knowledge-bases is growing rapidly, and the need to do this in creative and innovative ways presents us with new and exciting opportunities. At the same time, there is a constant need to reinforce just how important archives themselves are as a repository of knowledge. As progress has been made, the value of the project becomes ever clearer. For researchers from a wide range of other disciplines, and especially historians, digitization will allow the collection to be searched in a way that brings a leap in research productivity. Digitisation processes allow collections to be looked at and even identified in new and unexpected ways, whilst lessons are also learnt about the technical aspects of digitisation. Finally, this project is an excellent example of how partnership working between business and universities can be mutually beneficial and open up content for the benefit of students, researchers and wider society.

S072-C

Mon 22 July, 16:00–17:30 ▪ Uni Place 1.218

Chair: Joe ANDERSON | American Institute of Physics, United States

Keynote

Anne BARRETT | Imperial College London, United Kingdom

Securing scientific heritage: the Centre for Scientific Archives and the national strategy

The Centre for Scientific Archives plays a major role in developing and maintaining the foundation of a national strategy for the protection of scientific heritage. How is this achieved, how does working with knowledge revealed in the papers of scientists assist in this strategy, and who are the key players?

Gillian SHELDRICK | Centre for Scientific Archives, United Kingdom

Emily NAISH | Centre for Scientific Archives, United Kingdom

The Centre for Scientific Archives: perspectives on cataloguing the papers of prominent scientists

The Centre for Scientific Archives (CSA) has during the course of its life catalogued the archives of over 100 individual scientists. Both speakers from the CSA will illustrate their talks with examples drawn from current and recent CSA cataloguing projects, including the archives of Sir Joseph Rotblat, nuclear physicist and peace campaigner (1908 – 2005), Sir Gareth Roberts (1940-2007), research physicist, university administrator and educationalist and Sir Denis Rooke (1924-2008), engineer and industrialist.

Emily Naish will discuss how each archive has its own unique characteristics reflecting the personality, research interest and work methodology of its creator during the course of his or her life and career. However, archives created by different scientists also have much in common in their form and format. Using case studies from the CSA this paper will look at the ways scientists have recorded their activities, whether research, publication, teaching, interaction with government and industry or engagement with the public. Patterns and similarities across different archives emerge. In addition, there will be differences in a scientist's archive between 'official' records created intentionally such as lab books and reports, and 'unofficial' records such as personal correspondence and photographs.

Gillian Sheldrick will explore the challenges and opportunities involved in cataloguing archives remotely on behalf of a range of different archive repositories. Issues covered will include the importance of effective communication; dealing with differing conventions and standards in

respect of appraisal, packaging, numbering systems and cataloguing; working with large collections; and hardware and software compatibility.

S073. Medical knowledge at the colonial work front: health reports as research tools

Tue 23 July, 14:10–17:40 ▪ Uni Place 4.212

Symposium organisers:

Cristiana BASTOS | University of Lisbon, Portugal

ZAMPARONI, Valdemir | Federal University of Bahia, Brazil

Symposium abstract

For this symposium we aim to bring together anthropologists, historians and science studies scholars who use colonial health reports as a primary source in order to analyse the localized, situated production of medical knowledge, taking into account the asymmetries and cultural diversity of colonial settlement and rule, plantation systems and contexts of frontier. Our central questions are: how do colonial officers and health workers report their work at the clinical and public health fronts? What sort of knowledge do they produce while performing clinical work? In which ways do objects, relations and interpretations combine into knowledge making? What sorts of flows, channels and agencies shape the circulation, negotiation and making of new knowledge? Contributions will come from scholars actively engaged with colonial health reports, drawing mostly from India, Mozambique, Angola, Guinea/Cape Verde and S Tome.

S073-A. Writing knowledge: colonial physicians

Tue 23 July, 14:10–15:40 ▪ Uni Place 4.212

Chair: Kapil RAJ | EHESS, France

Eugénia RODRIGUES | Instituto de Investigação Científica Tropical, Portugal

Medical knowledge and medical writings: the making of colonial medicine in Mozambique in the first half of the nineteenth century

The literature on the history of medicine, such as on the history of science in general, has been focusing on the study of the global circulation of knowledge, drawing attention to local processes. Considering this scope, it is worth examining the role of European doctors who performed in the colonial territories, which, having arrived there with several European knowledge, tried to accommodate them to new geographical, social, cultural and political contexts. Frequently far from the theory and the practice learned in European universities, these territories have become places of circulation, reflection and production of medical knowledge, often interacting with the local knowledge.

During the first half of the 19th century, the medical theories of hygienist tradition and Enlightenment formulation postulated a strong connection to the knowledge of the environment, and this spurred the investigation of these doctors on issues of health and disease in imperial societies in which they worked. In the case of Mozambique, then part of the Portuguese empire, the chief-physicians of the Royal Hospital, several of them non-Portuguese Europeans, tried to apply medical European knowledge in the territory, considering the environment and the diseases existing there. They saw medicine as a tool for the Portuguese rule in this region or just as a means for promoting the establishment of

Europeans in a tropical environment. Anyway, they were not irrelevant actors of the colonial process.

The writings of some of these physicians, from health treatises, medical topographies or simple reports, the most part still in manuscripts, reveal attempts to accommodate European theories to the morbid circumstances found in Mozambique. Sometimes, this process required not only challenge certain ideas of the European medicine, but also a dialogue with the local knowledge, be this African or already hybridized by the colonial community.

The aim of this paper is to analyze the texts of some of the unknown doctors who acted in Mozambique during the first half of the 19th century, highlighting their role in the production of a colonial medicine. Based on their academic training, in the research they conducted in the colony and in their hospital practice, they produced new medical knowledge, unveiling diseases, trying new therapies and prescribing measures for individual and public health.

ZAMPARONI, Valdemir | Federal Univesity of Bahia, Brazil

Conhecimento médico africano e europeu em contexto colonial: notas sobre Angola e Moçambique.

Os relatórios dos médicos a serviço das repartições coloniais de Saúde de Angola e Moçambique e a documentação primária dos fundos de Saúde dos Arquivos Nacionais das duas maiores ex-colônias de Portugal em África, elaborados no século XIX e na primeira metade do século XX, embora carregados de preconceitos eurocêntricos, são fontes fundamentais para entender as concepções médicas vigentes naquele tempo; as dificuldades na compreensão, identificação e tratamento de doenças exóticas; as estratégias e dificuldades dos médicos a serviço do colonialismo para conquistar corações e mentes dos “indígenas”. Ao mesmo tempo, as narrativas sobre as resistências dos nativos e os obstáculos nesta caminhada “humanitária e civilizadora” oferecem a oportunidade para que emergam as vozes dos nativos, que não podem se expressar diretamente através das fontes escritas. Assim esta comunicação pretenderá analisar tal documentação em busca destes momentos de tensão resultante do encontro/confronto, no terreno, entre médicos a serviço da bio-medicina e os “indígenas”, e suas concepções de saúde, doença e cura.

African and European medical knowledge in a colonial context: notes from Angola and Mozambique

The reports written by physicians employed in Angola and Mozambique colonial-era Health Services, so much as other funds related to Public Health held by National Archives in the two largest of Portugal's former colonies in Africa, produced from the nineteenth through the first half of the twentieth century, albeit filled with Eurocentric prejudices, are key to the understanding of the prevailing medical mindset at the time; the harshness involved in diagnosing exotic diseases and prescribing adequate treatments; as well as the strategies of physicians at the service of colonial administrations in order to win hearts and minds of the “native”, and the difficulties thereof. Furthermore, the accounts regarding natives' resistance and the obstacles found in treading this “humanitarian and civilizing” path offer the opportunity for the voices of African colonial subjects to emerge, they who usually cannot express themselves directly through written sources. This paper seeks to investigate this documentation in search of such moments of tension ensuing the encounter

/ confrontation on the ground between Biomedicine-attached physicians and the “natives” and their conceptions of health, illness and healing.

Cristiana BASTOS | University of Lisbon, Portugal

Working with local knowledge: medical reports from colonial Goa

The condition of the hospitals, epidemics, airs, winds, fevers, local customs, venereal control, immunization, urban sanitation, sewage, pigs and laments about the shortage of means to promote the appropriate sanitary order are the most common topics referred in the 19th and early 20th health reports from Goa, India, written by Portuguese head physicians or surgeons. A tension between the need to express the boundaries of appropriateness and the overall goal of health promotion pervades the reports: while pretending to act, think and write as gatekeepers of a European code for the governance of life and health, the authors also report the occasions in which they follow local procedures in a pragmatic way to attain their goals. In this paper I will analyze some of the cases in which local knowledge and practices are subject to inquiry and reflection, and I will focus on one peculiar element of Goan material culture that led to some commentary in the health reports: the role of pigs in urban and rural sanitation.

Madhwi JHA | University of Delhi, India

Reporting indentures: health and hygiene in colonial Natal, 1860-1911

Natal had fifteen central hospital established for the Indentured Indians. It was the duty of every central hospital's Medical Surgeon to submit an Annual Report of his circle to the Emigrant Protector. In the Annual Report, the Medical Surgeon provided essential details of his circle regarding the health and sanitary issues of Indians. The Report discussed prominent diseases spread in the circle and the mortality rates. It also contained the number of patients admitted and discharged during the year. The Annual Reports are rich source of information. The Commissions and Enquiry Reports like the Tuberculosis Commission, Major Grierson and Pitcher Report regarding the recruitment policy of emigrants in British Overseas Colonies are the major sources for reconstructing the medical history of Indentured Indians in the plantation economy of Natal. The main purpose of medicine was to control the epidemic diseases which were the main cause of the widespread deaths of the larger proportion of labour-force and on these epidemics also posed an immense threat to the survival of the white populations. These Reports throw light on the fact that in the plantation economy of colonial Natal—the indenture's bodies were treated like a commodity. These Reports unravel the colonial concerns related to indentured body. They show how ‘frail’ and ‘redundant’ were thrown out and how healthy male with ‘hard hands’ and well developed ‘round chest’ were recruited for the agricultural work in the plantation. The Report highlights the ongoing tussle between the “unclean”, “unhealthy” and “dirty” Indians and the colonial government's sanitation mission. The Annual Report of the Emigrant Protector and the Medical Inspector throw light on the health and sanitation condition of the indentured in the depot in India, ship voyages and then in the working space of plantations. The paper based on these Reports delineates the nature of medicine in the plantation economy of Natal. It also investigates the characteristics of these Reports and their significance in forming colonial knowledge that was so crucial to the working of the plantations economy of Natal.

S073-B. Writing, counting and accounting for public health: empire, state and nation

Tue 23 July, 16:10–17:40 • Uni Place 4.212

Chairs:

Cristiana BASTOS | University of Lisbon, Portugal

ZAMPARONI, Valdemir | Federal Univesity of Bahia, Brazil

Jayanta BHATTACHARYA | Independent scholar, India

The rise of hospital medicine in India: a study using case records

From today's medical perspective, there is little mention of case records in India. With the arrival of Western medicine in India in the 18th century, there emerged the practice of keeping case records in hospitals erected by European powers. It did not automatically lead to hospital medicine, which required physical examination, autopsy, statistics and museums for preserving the cases. The foundation of the Calcutta Medical College in 1835, built on the model of University College of London, ushered into it. Serial experiments in Calcutta like producing native dressers in Madras establishments, the founding of the Native Medical Institution (1822) for native doctors, introduction of medical classes at the Sanskrit College and Madrassa etc. preceded it. The 18th-19th century case records were of European soldiers by European doctors. Almost every surgeon had charge of 700 patients. They would keep a regular diary of cases. In 1826, Tytler had introduced keeping case records in Persian by the NMI students. The conceptual basis of clinical case is the ordering of its facts by the agency of time. Its material dimension is the transcription of this evidence in written form, thereafter embodied as a medical record of observed events. After 1826, the keeping of case records was internalized by Indian students. Till then they did not perform dissection beyond zototomy. Hence the cases were actually records of symptoms, instead of signs which were to be confirmed through pathological anatomy. The transition was made possible through CMC. In CMC, students were to examine patients at the bedside, perform dissection after his/her death and keep records which were to be produced during examination. At the same time, they had to keep records of both medical and surgical cases, and the reports of experimentation the Jennerian vaccine and various drugs – both European and indigenous – on patients. Along with CMC, through the Medical and Physical Society of Calcutta (1823) and its journal *Transactions of the Medical and Physical Society of Calcutta* (1825) circulation of medical, surgical, and pharmaco-botanical knowledge throughout India and to Europe became practicable. The introduction of anatomical dissection secularized both the notion of the body and medical education stripped off from caste prejudice and parochial hierarchy. The hospital case records became a materiality through internalization of hospital medicine in its full gamut by Indians like S G Chuckerbutty.

Rosa WILLIAMS | University of the Free State, South Africa

Categories and classifications: reading colonial medical statistics

The 1895 regulations on Portugal's colonial health services described "medical statistics" alongside "climatological and ethnographic studies" as "the basis of all scientific colonisation." Megan Vaughan argues that colonial medical discourses in Africa constituted 'the African' (or 'the native') as an object of knowledge. The completion of medical tables documenting individual users of medical facilities and differentiating this population on various axes was a significant discursive practice that reinforced authoritative claims about Africans as distinct kinds of medical subjects. Focusing on the collection and the increasing standardization of data on the few people who used or were brought to colonial hospitals in Mozambique from the late nineteenth century, this paper suggests that closer attention to the form as well as the content of statistical tables produced by colonial medics can enrich our understanding of the production of colonial medical knowledge.

These practices of administration, accounting for the work of hospitals, however limited their number and scope, in a formally rational manner can be understood as self-consciously modern, state-like behaviour. But health department correspondence also reveals that in the years in which it was being so carefully standardized, this activity itself was upset in practice; colonial bureaucrats themselves had to be disciplined to behave as modern colonial subjects. Moments of failure in fulfilling the counting and classificatory responsibilities of a state, point to the

frustrations of the colonial authorities in realizing their own vision of a modern state.

Tables on hospital 'movement' failed either to record or to impact directly the health of more than a fraction of the inhabitants of this precariously won territory. Still, they were infused with a biopolitical concern with observing and producing colonial subjects as members of a population. Tables don't just enumerate; by defining they can also create. And in the reports published alongside hospital tables, colonial medics employed the data produced through these bureaucratic practices of record and measurement to produce narratives which explained the dangers which these 'native' subjects posed, to the colony as an organic whole, or to a community of colonial settlers imagined as bounded and independent, but also their terrible vulnerability to corruption and contagion.

Samuël COGHE | Max Planck Institute for the History of Science, Germany

Depopulation anxieties and medical demography in Angola during the interwar period

In the first decades of the twentieth century, many colonial administrators, doctors and other agents in tropical Africa were haunted by the spectre of population decline. The idea that the African populations under their rule were declining, or at its best, stagnating, was at odds with core aspects of colonial ideology. A healthy and growing 'native' population was deemed indispensable to implementing the economic *mise en valeur* of the colonies and to attesting the very legitimacy of colonial agents as bearers of progress and civilization. Observers mentioned a wide variety of causes for depopulation, notably epidemic and endemic diseases, alcoholism, 'native' customs, labour conditions, outbound migration, low birth and high infant mortality rates. Accurate demographic data, however, were scarce.

In this presentation, I will focus on the role of medical doctors in producing and using demographic data in the Portuguese colony of Angola, during the Interwar Period. I will show that, in the second half of the 1920s, medical doctors began to collect demographic data on the Angolan population in a far more systematic way than before. This rise of medical demography was closely linked with new health programmes, which aimed at extending biomedical care to rural African populations. In the concept of social medicine that underpinned these programmes, demographic data were considered a fundamental tool. Acting as 'field demographers', doctors had recourse to new methods such as individual registration cards, sample techniques and oral interviews. Nevertheless, the collection of demographic data continued to depend on the collaboration of the African population, an issue which doctors' reports assess in varied ways.

I will also argue that, while doctors collected information on all types of population 'movements' (natality, mortality and migration), they showed particular interest in natality related issues. This can be observed in other colonies too. It both reflected and reinforced a shift in colonial discourse on depopulation. In the Interwar Period, epidemic and endemic diseases were gradually being replaced by low fertility and high infant mortality as the most important factors of population decline/stagnation. Here, I will demonstrate that doctors used their demographic studies to dismiss the idea of low birth rates in Angola and to emphasize high infant mortality as the major problem to tackle.

S074. Connected histories? Science and technology from a new historiographical perspective

Tue 23 July, 09:10–12:40 • Uni Place 4.205

Symposium organisers:

Maria Helena ROXO BELTRAN | Pontificia Universidade Católica de São Paulo, Brazil

Patrice BRET | Centre Alexandre Koyré, France

Symposium abstract

The subject of this symposium is the historical transformations of the mutual relationships between science and technology from a perspective grounded on contemporary historiographical views specific to the history of science. Therefore, we propose a discussion of such relationships focusing on the different historical modes how the knowledge on nature and art (techné) was recorded and conveyed.

Recent studies grounded on novel historiographical approaches stress the need to discuss the relationship between science and technology in the terms of the interaction between knowledge and action. Such studies seek to understand not only the development and elaboration of scientific and technological knowledge, but also to analyse the nature of their mutual connections. As a result, topics like experimental methods, laboratory work, instruments and other equipment, the relationship between science and industry, or science, technology, and work, among many others were approached from several different perspectives.

Nevertheless, although such historical studies sought to understand and describe the nature of the mutual connections between science and technology, little research was performed on the transmission of such knowledge, the material support that ensured it, and its implications for the development of new scientific and technological knowledge.

S074-A

Tue 23 July, 09:10–10:40 • Uni Place 4.205

Chair: SAITO Fumikazu | Pontificia Universidade Católica de São Paulo, Brazil

María Blanca RAMOS DE VIESCA | Universidad Nacional Autónoma de México, Mexico

Hygienic public regulation and therapeutics methods for syphilis in Mexico, 1940-1960

The syphilis has been one of the diseases that has accompanied the human civilization from his origins to the present time. Outlined in Fracastoro's works in the 16th century, his contagious origin it is recognized. From the 20th Century onwards, when the treponema pallidum and the infections mechanisms were discovered, there were established hygienic procedures. It is known that before the introduction of the penicillin, in 1944 in the United States of North America, 65 % of the neurological organic patients of the Cook Country Hospital of Chicago were suffering neurosyphilis, the most serious complication of the tertiary Stadium. 8 of every 10 patients were suffering worldwide this complication. In Mexico, The Mexican Institute of the Social Security in 1944 had total population registered 22% of the total population seeking medical services and 77 % were suffering neurosyphilis. In the Mayo Clinic in the USA were registered 4 % and 65-78 % they had neurological manifestations. In the General Mental hospital of Mexico City (Manicomio de la Castañeda) existed an special Pavilion that was sheltering this type of patients in his terminal phase. The Mexican government worried by the presence of the syphilis carry out different boardings in order to eradicate it, epidemiological, clinical and legal issues. This work takes as an aim the analysis of the policies of health carried out during the decade of the years 1940 to 1960, fundamental time for the eradication of syphilis in Mexico

Gilson Leandro QUELUZ | Universidade Tecnológica Federal do Parana (UTFPR), Brazil

Neo-Malthusianism and eugenics in the Brazilian anarchist thought of Maria Lacerda de Moura

This paper aims to analyze the problematization of eugenics and neo-Malthusian thought in Brazilian anarchism through the texts present in the book *Amai e não vos Multipliqueis* (1932) and in *Renascença* magazine (1923) of the libertarian and feminist Maria Lacerda de Moura. The analysis will look at the observations of Álvaro Sierra in *Darwinismo Social e Izquierda Política* (2005) regarding the importance of making a social history of the appropriation of scientific and technological knowledge that tries to perceive the processes of transformation of this knowledge in popular classes. A social history of science and technology that is aware of the specificities of the political subculture, such as the anarchist, and whose premise is the plurality of the "political culture of the popular classes". Therefore, when we consider in the anarchist ideology the central character of the role of science as emancipating and revolutionary, it becomes fundamental a view of the political culture which, by adopting an interdisciplinary attitude, allows the perception of the narratives and libertarian social practices on such themes as technology, eugenics, neo-Malthusianism, sexuality and vivisection. Such themes permeate Moura's literary works and political articles. In the analysis of the narratives we will use the methodological care, indicated by Richard Cleminson in his study *Eugenics without the state* (2008), of refusing to assume essentialist notions of science and technology, and worrying about defining them through the concepts proposed by the anarchists themselves. Put differently, the concepts and practices that involve science and technology will be understood in the national historical context of the actual social movements, and its political and ideological struggles. Cleminson demonstrates in his analysis the importance of this approach by stressing that contrarily to the common sense definition of eugenics as rightist, racist and linked to the state, several anarchists appropriated the concept of eugenics, contradictorily, as a critical instrument to capitalism, a way to strengthen the living conditions of the working class and to exercise conscious sexual freedom. We will see in the texts of Moura the defense of the adoption of neo-Malthusian techniques as a constituent element of the "conscious maternity", central to the libertarian project of the female emancipation.

Irina GOUZEVITCH | École des Hautes Etudes en Sciences Sociales, France

Gouzevitch DMITRI | École des hautes études en sciences sociales, France

L'art de la lithographie comme nouveau moyen de communication techno-scientifique : la naissance de la « littérature grise » (première moitié du XIXe siècle)

La valeur artistique de la lithographie a longtemps dissimulé ses autres domaines d'application. Parmi ses usages précoces figurent, en effet, les partitions musicales (1796) et les cartes (1802) lithographiées. La production des illustrations lithographiées bon-marché a stimulé l'essor du livre scientifique et technique dans le premier XIXe. De nouvelles applications de la lithographie ont marqué un tournant décisif dans la communication professionnelle des ingénieurs. En 1816, l'atelier lithographique organisé par G. Traitteur à St-Petersbourg, publia le « Cours des constructions » à l'usage des élèves de l'Institut des ingénieurs des voies de communication. Ce cours lithographie fut suivi par d'autres, dans les différentes matières. Un nouveau type de livre technique est ainsi né. - Un album de dessins publié dans ce même atelier (1816) inaugura un autre type d'édition technique, les dessins lithographiés. Son inventeur en France fut Antoine Raucourt, fondateur du premier atelier lithographique à l'Ecole des ponts et chaussées. Parmi d'autres usages de la lithographie, citons les supports visuels des conférences (utilisés par G. Lamé, à l'Ecole polytechnique).

La mise en place, vers 1839, du procédé de reproduction dit « litho-typographique » offrit la possibilité de reproduire tous textes et dessins en quantités illimitées. Le procédé lithographique cumula alors les fonctions anticipant les techniques de reproduction contemporaines dites

communément la « littérature grise ». Une nouvelle étape ne commencera qu'avec l'introduction de l'informatique.

La communication se présentera en deux volets, le premier pourtant sur l'évolution et l'expansion des usages multiples de la lithographie, ce procédé synthétique né et appliqué à cheval entre la science, les techniques et les arts, qui a révolutionné la communication technoscientifique, alors que le second concernera le rôle des représentants des professions non-artistiques, ingénieurs et savants académiques européens, dans la mise au point et l'essor de ce procédé. La rencontre des deux mentalités – traditionnelle corporatiste qui tend à protéger les secrets de l'art et celle d'un expert techniques savant au service de l'Etat qui systématise ce savoir sous forme d'un traité technique afin de le rendre public – sera également examinée.

Lais TRINDADE | Independent scholar, Brazil

Distillation as a process for obtaining medicines in seventeenth-century Paris

The seventeenth century witnessed an intense debate about medical ideas. In Paris, in particular, there were different conceptions about the best way to cure diseases, and many books describing procedures for preparing medicines were edited. Many of these publications were compilations of old recipes adapted to the era, often bringing up-to-date products that became available in Europe after the discovery of the "New World". Such books include *La Chymie Charitable et Facile en Faveur des Dames*, originally published in 1666, and apparently the only work signed by Marie Meurdrac. Marie Meurdrac's recipes were based on her understanding about the matter, which, according to her, was formed by a universal and unique principle that generated three others, namely: mercury, sulfur and salt. These, in turn, formed three other principles, bearing different qualities present in the final products of distillation, as demonstrated by experiments. Meurdrac's triadic conceptions were also based on the Holy Trinity. Consequently, they diverged from the tenets maintained by the teachers of the King's Garden, who tended to accept two additional principles obtained by distillation or through reduction by fire. Considered passive, these two principles were water and earth. It is possible the Meurdrac's ternary principles were influenced by Joseph Du Chesne, who states in his *Traicté de la Matière* (1626) that matter was formed by three principles that existed in the same essence, but distinguished themselves by their properties, similarly to the mystery of the Holy Trinity. For both Meurdrac and Du Chesne, the purest "spirit" could be obtained by successive distillations. Even though present in *La Chymie Charitable*, the idea of preparing medicines by the distillation of curative substances, separating pure essences from impure matter, derives from fifteenth-century books of distillation. Distillation ensured the excellence of the final products because this method furnished the subtlest part of any material. Thus, the aim of this paper is to present some considerations about the operations and techniques used by both authors to obtain medicines.

Maria Helena ROXO BELTRAN | Pontificia Universidade Católica de São Paulo, Brazil

Distillation in the sixteenth century: between science and chemical art

Current studies have reaffirmed a strong relationship between knowing and doing in the processes of elaboration, transmission and transformation of knowledge about matter, which in history, as it is known, have been documented and developed through the reflections and practices carried out by alchemists, metallurgists and apothecaries - among other groups of scholars and artisans - during the 16th century. These documents included recipe books, treatises and encyclopedic texts, which could be found circulating more intensely in Europe from the 14th century on. A common feature found within the documentation is their approach to changes regarding the ideas about science and technology, as well as the classification of knowledge. In previous research we had discussed the effectiveness of the traditional

classification of texts - concerning ideas about the composition of matter and chemical/alchemical procedures - as either "theoretical" or "practical". However, according to traditional historiography, we have realized that content and format have been the prior criteria in analyzing these texts. We understand that it is necessary to take into account a conceptual discussion of the notions and relations between nature and art, as of science and technology. Besides, research on the ways these concepts have developed, have been transmitted, adapted and / or modified in different cultures and eras, shows that the classification of these texts should not only involve the internal analysis of a group of similar texts, but also the search for their sources, as well as the ways and reasons of their development, and when they were written or compiled. This paper focuses on the ancient art of distillation - given its prominent role in both obtaining medicines and powerful "waters" used by apothecaries and metallurgists - as the reflections on the composition of matter manifested in different types of texts. Thus, we analyze in particular the *Liber de arte distillandi ...* (1500) written by the surgeon H. Brunschwig, *De la pirotechnia* (1540) a work of the metallurgist V. Biringuccio and *De re metallica* (1556) a treatise of the humanist physician G. Agricola, in order to identify conceptions of science and technology, as well as possible relationships between them. (Supported by Fapesp Processo No. 11/14040-9)

S074-B

Tue 23 July, 11:10–12:40 • Uni Place 4.205

Chair: Gilson Leandro QUELUZ | Universidade Tecnológica Federal do Paraná (UTFPR), Brazil

Joseph KOUNEIHHER | University of Nice Sophia Antipolis/IUFM, France

Technology and science: some interactions

Technology is an intrinsic part of a cultural system and it both shapes and reflects the system's values. We use technology to try to change the world to suit us better. The changes may relate to survival needs such as food, shelter, or defense, or they may relate to human aspirations such as knowledge, art, or control. But the results of changing the world are often complicated and unpredictable. Indeed, in the past Science and Techniques meant different things. People working in these two domains used different skills, even if sometimes we found people developing a two side skills (think of Newton and Galileo etc.). However, by the end of the 20th century, a relationship between the two domains became a reality. Even the methodologies underlying the two domains became almost the same. Even more, each one of them needs the other to stabilize its evolution and confirm their assertions. The Nobel Prize of this year 2012 is a good example. Thanks to some special technologies we succeed to isolate a photon, rendering the thought experiences of quantum mechanics a macroscopic reality, and confirming de facto some proprieties of the quantum vision of our world. We can say the same thing about the GPS and general relativity. Consequently, today we start to hear about a unified methodology underlying sciences and technologies. In teaching, for example, an "investigative approach" based on the laboratory investigation behavior to understand the phenomena is required to a constructive teaching. So, underlying teaching science and technologies there is a unified scheme, and we are invited to imagine a different approach to handle the transmission of knowledge with some insistence on the following points: a) Understanding of the global system b) Capacity to think analytically and creatively within disciplines. c) Ability to tackle problems and issues that do not respect disciplinary boundaries. d) Knowledge of and ability to interact civilly and productively with individuals from quite different cultural backgrounds—both within one's own society and across the planet. e) Fostering of hybrid or blended identities. In this paper we focus in the link between technology and science: past and present, and we will try a conjecture for the future. Starting from this perspective we analyze and suggest some new approaches for teaching technological

sciences and scientific technologies. This duality is from now a reality and it is here to stay. But could we imagine the next auto-duality which is at the heart of mathematics: proof of mathematics by a machine calculus.

Konstantinos CHATZIS | École des Ponts ParisTech, France

The Marathon dam (1926-1929): a collaboration of American and Greek engineers

Many historians serving the field of the history of technology have concentrated their research efforts on a handful of nations deemed the sole interesting actors participating in the race for technological innovation. This almost exclusive focus on a very small number of nations, to the detriment of the supposedly uninteresting multitude, has led to the conception of the technological transfer as a bipolar and mono-faceted process that comprises an active “transmitter” and a more or less passive “receptor”, and involved no significant transformation. Following in the footsteps of some trailblazing historians of science and technology who have challenged the above-mentioned views and practices, we would like to present a case study that reveals extensive cooperation between a scientifically and technologically advanced nation and one located on what was conventionally regarded as the edge of the developed world of the time. Built by American contractor Ulen&Company from 1926-1929 to provide water to Athens, the Marathon dam was by no means a purely American product as Greek engineers played a key role in many aspects of its planning, design and construction. And paradoxical as may appear, they were the Greek engineers involved in the project who injected “high” science into the Marathon dam design and building process, while their American counterparts demonstrated in their practices a series of qualities that made them practical rather than “theory-minded” men.

This presentation is based on work co-authored by Georgia Mavrogonatou.

Isabel MALAQUIAS | Universidade de Aveiro, Portugal

At the science-technology border: J H de Magellan (1722-1790), a curious case

The essence of mathematical practice had multiplied in progressively refined techniques and specialization increased while the practitioners detached as well, during the eighteenth century. Mathematical instruments were the application means, and practitioners still maintained a close connection with the instrument-makers, exchanging ideas on new designs and methods. This led to an end after the 1790's. At the same time in England, at the Royal Society, we can come across with individuals as famous as Joseph Priestley, Sir John Pringle, Benjamin Franklin, Nevil Maskelyne, Sir Joseph Banks or George Graham, Joseph Bird, Jesse Ramsden, being not the technical status an impediment to become a Fellow. The Portuguese J. H. de Magellan leads us to a case where a curious intrinsic attention on mathematical and mechanical instruments coexisted with a more general interest in science, as chemistry subjects for instance, and a strong aptitude to communicate. This mixture in just one character was not common at the time and gave place to diversified activities as getting a patent with Henry Pyefinch, the instrument-maker, on a type of barometer, to be a jury member of the mechanics section at the Society of Arts of which he was a member, to discuss modifications on barometers presented at the Royal Society, to persuade James Watt and Mathew Boulton to obtain a patent on their steam engine, to supervise the needles for the Royal Navy or the acquisition of astronomical and physics instruments for the expeditions of borders delimitations of the 1770's in South America. In this paper we will seek to discuss why this case is interesting, the context of its development and try some conclusions.

Javier ORTEGA MOREL | Universidad del Estado de Hidalgo, Mexico

Patricia ACEVES | Universidad Autónoma Metropolitana Xochimilco, Mexico

Change in silver ores benefit, from amalgamation to cyanidation, the case of Pachuca, Hidalgo, México, 1902-1912

In the 16th century the amalgamation method with mercury was developed in Pachuca, to extract silver from minerals. In later centuries the preferred method to process the common ores, was the patio method system. From 1846, the so-called refractory or rebellious metals were processed by Born or barrels method and was gradually increasing the percentage of ore processed by this system. At the end of that century, the continuous method of pans used was an adaptation of variants originated in United States. The mechanization of the patio, applied from 1902 to 1906, was the last effort to keep alive the amalgamation. The new method of cyanidation applied in Pachuca from 1903, was a significant benefit improvement. It was based on the solubility of gold and silver by compounds such as sodium or potassium cyanide, observed since 1840. The patent for an industrial method using cyanide was obtained in 1886, by J. S. MacArthur, R. W. Forrest and G. Morton. The first applications to gold-rich minerals were a success. The advantages of cyanidation were: quickly process, better recovery of values, higher capacity for processing all types of minerals and the avoidance of a dangerous heavy metal handling. Implementation of this method for silver minerals was achieved in Mexico between 1903 and 1904. In Pachuca, the establishment of the cyanidation required local understanding of specialized knowledge to achieve the best results. It used high agitation tanks initially developed in New Zealand that improved locally would be known generically as Pachuca tanks. Thus, in the study period, the latest industrial applications, the amalgamation and the cyanidation with two variants: the agitation-decantation tanks and the Pachuca tanks coexisted in the region. In the cyanidation, changes were made to the procedure for precipitating the values; the procedure changed from zinc chip boxes to the dust of the same metal used in the Merrill-Crowe process. High performance equipment such as crushers, mills and conveyors, were applied in the milling, these changes in addition to the speed of the new method, allowed for the processing of much more ore tonnages than ever before.

José Luiz GOLDFARB | Pontificia Universidade Católica de São Paulo, Brazil

Mercator and the world of maps, some historical and philosophical reflections

Our presentation is about Gerardus Mercator (1512-1594). Besides a cartographer, he was a calligrapher, carver and engraver on copper plates, manufacturer of scientific instruments (compasses, rules and triangles), of geographic and celestial globes and also map editor. However, it is the world-map of 1569, in a map projection different from everything else existing that moment, and that lasted for over 400 years as standard for maps, that will be, in Gerardus Mercator's universe, the main focus of this study. Throughout millenniums, one of the main issues in several societies was to understand the limits of the Universe. For the Greek people, to understand the nature was one of its main concerns and within this comprehension was the geographic world. Their “Geography” was limited to what the Greek used to call the known world or the Oikoumenē and, thus, it was this physical world the essential element to think of the meaning of cartography. A search through stars, planets, moon and sun, as well as by land, sea, rivers and mountains was the result for the demarcation of limits in their terrestrial and celestial space. Thus, philosophical ideas and concepts were essential for a new comprehension, a look around in order to understand this known world or the Oikoumenē and to be able to write and draw the shape that today is called maps or cartographic charts. In this field of investigation, procedures and ideas will be presented in order to reflect about the historical process that several thinkers and their societies experienced, characterized by specificities, advances and regressions, as well as beliefs, philosophical concepts and images about

the Earth, the Universe and man itself. And for that, contributions and main studies of astronomers, mathematics and geographers will be included, as well as analyses and critics of their predecessors. By developing this presentation about the cartographic journey of Mercator, in the History of Science context, we intend to demonstrate, mainly, how Geography enabled us to think and rethink of the limits of the known world. The increase of the space where we live depends on research projects, procedures, techniques and studies, many of which enable us to understand the world-space inhabited by different people, living in different cultures. Finally, it is essential to emphasize the importance of understanding man and its work in relation to the social context and its time.

SAITO Fumikazu | Pontifícia Universidade Católica de São Paulo, Brazil

Knowing and doing in the sixteenth-century natural magic: Giambattista della Porta and the wonders of nature

In the first book, chapter 3, of *Magia naturalis*, Giambattista della Porta states that: “Quoniam ipsam Magiam activam; & naturalis Philosophiae portionem describimus...”, i.e., “Seeing Magick, as seen before, is a practical part of Natural Philosophy...”. By this Della Porta referred to knowledge of a particular set of phenomena which would enable him to operate nature from within. Actually *Magia naturalis* covers a broad spectrum of issues which include topics related to the art of distillation, perfumes, fireworks, cookery, fishing and hunting etc. The purpose of all these subjects was to survey whole natural and artificial things in order to reproduce them. One could infer that each phenomenon described in *Magia naturalis* was singular and could only be known through empirical bias of investigation. That is why all reports in his *Magia naturalis* are reduced to the formula: “how to make, how to do etc”. In this sense, one could say that natural magic is a kind of art (*techne*) in the Aristotelian sense because it implies the sort of knowledge which depends on the ability of those who will manipulate phenomena. That is why the conception of natural magic is usually closely associated in meaning to “skill”. Although natural magic approaches in meaning to art (*techne*), it somehow does not address a skilled craftsman because a magician should consider theoretical background as well as practical knowledge. It was expected from the magician to have an acute knowledge of natural philosophy in order to articulate such theoretical part with that of practical counterpart. Therefore, a magician was not a mere craftsman for he should take into consideration not only the material but also how to manipulate nature using the necessary tools. In other words, since a magician had to deal with singular and rare phenomena, he had to consider all materials and know how to prepare and organize them. The aim of this paper is to point out that natural magic was a science closer in meaning to *techne* because it had a concrete sense of craftsmanship with the connotation of the ability to devise stratagems. However, once it had not been limited to the intellectual or manual activity, it could not be considered a mere technical art, or technical science, meaning technology or technique. (Supported by Fapesp Processo No. 11/14040-9)

S075. Publishing the sciences

Mon 22 July, 11:00–17:30 ▪ Uni Place 3.204

Symposium organisers:

Aileen FYFE | University of St Andrews, United Kingdom

Eirini MERGOUPI-SAVAIDOU | National and Kapodistrian University of Athens, Greece

Symposium abstract

This Symposium focuses on the importance of communication in making knowledge work, for it is through communication that individual facts become public knowledge. We are intentionally collapsing the usual dichotomy between scientific communication and popularisation, by including contributors interested in the communication between scholarly specialists, as well as those who focus popularisation activities, whether by scientific experts or others.

The printed word has dominated scientific communication for several centuries in the form of books, learned journals and popular magazines. The editorial and commercial practicalities of the publishing trade have shaped the communication of scientific knowledge as much as authorial intentions, and our contributors will all devote careful attention to the ways in which scientific communication was shaped by publishing practices.

The Symposium takes advantage of the opportunities offered by the international Congress, by bringing together scholars from many national communities, to enable comparative, trans-national discussions to take place. Our papers address topics from Britain, France, Spain, Portugal, Greece and the Ottoman Empire. We are linking scholars from STEP (Science and Technology in the European Periphery) with those who work on the better-known British context, to try to create a truly European vision of science publishing activities.

We have also made a point of including speakers representing a long timeframe. The 19th century is clearly the heart of the Symposium, but we have sought to extend our chronological coverage in both directions and hope that this longer *durée* will enable a more nuanced picture of the development of the spectrum of scholarly and popular publishing activities.

S075-A. Scientific intelligence and expertise

Mon 22 July, 11:00–12:30 ▪ Uni Place 3.204

Chair: Aileen FYFE | University of St Andrews, United Kingdom

Noah MOXHAM | University of St Andrews, United Kingdom

Extracts, imitations, adaptations: the *Journal des sçavans* in the *Philosophical Transactions* and the *Philosophical Transactions* in the *Journal des sçavans*, 1665-1699

While the importance to the history of science publishing of both the *Journal des Sçavans* and the *Philosophical Transactions* – respectively considered the first learned journal and the first scientific journal, first appearing two months apart on the cusp of 1665 – has long been acknowledged, the early history of both is surprisingly incomplete. Both are major resources for cultural historians and historians of science, both have had their early issues fully digitized and made freely available online, and yet there have been few attempts to analyse the patterns of editorial activity in either of them. For journals generally supposed to have been instrumental in giving posterity the peer review process, the research article, and the book review, there are important lacunae in accounts of their early history and very little research that seeks to compare them directly. The following paper seeks to begin that work. It will investigate the nature, extent and forms of the two journals’ mutual borrowings; where and whether they were fashioned through consenting editorial exchanges; and explores the significance of those patterns in fashioning contemporary natural-philosophical debates and controversies, as well as establishing the future courses of the learned journal. It aims at a fine-grained examination of an important nexus between English and French natural philosophy in the 17th Century, which has hitherto been drawn only in broad, contrastive brushstrokes, and will argue more generally that close examination of the history and practices of publishing science in the two countries in this period enables us to uncover a much livelier awareness and responsiveness in each

community to the other's work than current historiography generally allows.

Jesus M. GALECH | Universitat Autònoma de Barcelona, Spain

A public (de)construction of medical expertise in early eighteenth-century Spain

By the end of the Spanish War of Succession in 1714, publishing of all sort of works reactivated and many of the scientific polemics that had started during the 17th century emerged again. In particular, the publishing all sort of papers against traditionalists in science and arguing in favour of bringing Spanish science closer to European scientific novelties written by a group of Spanish thinkers labelled as the *novator* movement, mostly high-rank physicians. Although their ideas can not be identified with a coherent and unitary thinking, at the turn of the century they had created the Regia Sociedad de Medicina y otras Ciencias de Sevilla, the first scientific society in Spain. By 1724 these debates aimed at learnt audiences focused on the characterisation of modern medicine, being the most representative *novator* author the physician and professor of anatomy Martín Martínez, who was about to become the president of the Regia Sociedad. He defended a new medicine deeply rooted in scepticism and tried to define the education, duties and public image of an expert in medicine.

This paper will show how these efforts of constructing a new medical expertise through scientific publishing entered the popular domain and developed under such new circumstances. When in August, 1724, the young King of Spain Louis I died of smallpox, a strong controversy about the usefulness of medicine and physician's practices arose and extended to all possible audiences. In addition, many people believed that the King's death had been predicted in the best-seller almanac *Piscator de Salamanca* published earlier that year. His author was Diego de Torres, a popular science, poetry and satirical works writer, astrologer and professor of mathematics and astrology at the University of Salamanca. He started a vastly publicised polemic with Martín Martínez criticising his new ideal of medical expertise and forced the physician to address larger and popular audiences. Each one of them developed different programs of science popularisation, but their efforts were strongly reshaped by Juan de Goyeneche, one of the most important contractors in the Kingdom and owner of the publishing enterprises that backed Diego de Torres.

María TERDIMOU | Hellenic Open University, Greece

Not only for the profit of the publishers but also for the benefit of the nation: Greek publications during the eighteenth century

In this paper, our aim is to examine the subject of publications of Greek scientific textbooks during the 18th century and the two pre-revolutionary decades of the 19th century.

The initial movements of Greek scholars in Venice began mainly after the fall of Constantinople. Very soon the Greek community of Venice came to be the most numerous and most significant community of Venice.

The blooming of printing and the spread of Greek studies had made Venice the pioneer of the cultivation of humanities since the end of the 15th century. The Greeks, Nicolaos Vlastos and Zaxarias Kallergis had established a printing office in Venice since 1499.

During the 18th century and till the beginning of the Greek Revolution several scientific publications saw the light of day. More specifically, eleven mathematical textbooks and fifteen on the field of natural sciences were published. These publications took place at the printing offices of Nicolaos Glykis, Panos Theodosiou and Antonio Vortoli .

Leibzig, Paris, London, Pesti, Livorno, Halle, Iena, Bucarest, Trieste, Padoua, Corfu, Constantinople and Bologna are cities where, during the 18th century, some publications of scientific textbooks took place as well. .

Last but not least is Vienna which was the most important centre of concentration and development of the Greeks of Diaspora, mainly during the last decades of the 18th century.

In the Austro-Hungarian empire, the Greek community played an important role in scientific as well as in social life. Many scientific books and journals were published in Vienna., which became a scientific publishing centre for the Greek nation.

Twenty three mathematical textbooks and thirty two on natural sciences were published from 1891 till 1820. Most of them, but not all, are translations or compilations of European textbooks..

Georgios Vendotis, Demetrios Alexandrides, Brothers Markides Poulou were considerable publishers in Vienna.

In this paper we shall examine not only where these publications took place, but also under which circumstances and what was their contribution to the improvement of the educational level of the new Hellenism. Apart from the publishers, several scholars, authors or editors were the main contributors to the whole enterprise. They knew that through these publications, the transmission of knowledge, in the form of compilations or translations from Europe, could reform the intellectual climate that had held sway over the enslaved Greek nation for centuries. They also believed that education was the strongest means of forming national conscience, and therefore the best motivating force for people who tried to gain their political and cultural freedom

Iain WATTS | Princeton University, United States

“Philosophical intelligence”: print, periodicity, and the traffic in scientific news between Britain and Continental Europe during the Napoleonic Wars

This paper pursues the question of how news about science moved in print culture during the disruptions of the Revolutionary and Napoleonic period. During this time, information about novel ideas or discoveries was consumed by a range of individuals, from an elite cadre of scientific devotees down to broad lay public audiences. From the discovery of new celestial bodies or exotic flora and fauna to dramatic experiments in electricity, ballooning, or gas chemistry, items of scientific news of great interest to specialist investigators could often be found identically served up for the entertainment or edification of lay readers in newspapers and general periodicals. I use examples from the fast-moving, spectacular and occasionally controversial science of Galvanism to uncover the international communicative system of print that propagated scientific news. At the heart of this system were the editors of a newly-founded set of British, French and German monthly scientific journals, whose publications regularly reprinted each other's news and articles, striving to offer the first published information on novel discoveries to their respective countries' scientifically-inclined readers. I will focus especially on the monthly knowledge-work performed by these editors of obtaining, selecting, and reprinting scientific news text, setting it against the shifting background of the disruptions and blockades of the Napoleonic wars, which constantly tested the ingenuity of these technicians of periodical print. This focus will lead to a display of how scientific news text flowed easily between what are commonly thought of as separate 'specialist' and 'popular' forms. Material lifted from scientific journals was frequently reprinted in newspapers and magazines; and in one special case which I will detail, a French newspaper consistently provided a crucial source of information for British journals. While acknowledging the vital role that continued to be played by personal correspondence in scientific communication, I will use Galvanism to show the complex ways in which scientific journals (which as the nineteenth century advanced withdrew steadily into their own sphere of expert scientific publishing) were in this period deeply embedded within the wider world of print, subsisting in a symbiotic relationship with other kinds of publications in the burgeoning news culture of the Revolutionary and Napoleonic years.

S075-B. Periodicals and popularisation

Mon 22 July, 14:00–15:30 ▪ Uni Place 3.204

Chair: Aileen FYFE | University of St Andrews, United Kingdom

Eirini MERGOUPI-SAVAIDOU | National and Kapodistrian University of Athens, Greece

Diffusion, 'popularization' and periodicals of science in late nineteenth-century Greece

Recent studies in the history of science call for the historicization of "popular science", the examination of its multiple aspects in various social and cultural contexts. In accordance with these studies, I will try to show the origins of both the concept and enterprise of the "popularization of science" in Greece in the late 19th century through the periodical press, as well as the relationship between "popularization" and "diffusion" of science. Periodical press was proved very important for the communication of science in late 19th century Greece, in a period when educational, professional and political institutions were under construction. From 1870s scientific knowledge, ideas and practices became accessible to the wide public mainly through the general reader press. At the same period, periodicals of applied science addressing specific audiences emerged. Political, intellectual and scientific elite of the country, motivated by various aims and pursuits, undertook these efforts covered by the general term "diffusion of sciences". "Diffusion of sciences" was part of a broader project in the social, political and intellectual context of Greece in the second half of the 19th century, declared as "diffusion of useful knowledge". In this project, both the ideology of progress, seen as moral and intellectual improvement of lay people, and the national ideology, which was epitomized in territorial, economic and cultural dominion of the country in Balkans and near East, were of great importance for shaping the public discourse of science and also being shaped by it. In contrast with the "diffusion of science", the Greek term that corresponds to the "popularization of science" emerged in the public discourse later, in the early 1890s. However, from the late 1880s few publications arose, that addressed a middle class audience and met with the characteristics of popular science periodicals, although they explicitly aimed at the "diffusion of sciences". The first to promote "popularization of science" as such were the science professors of the University of Athens, who considered it part of their scientific work and evidence of progress. These professors got involved with the publication of science periodicals and used popularization as vehicle for setting the boundaries of scientific discourse, asking for financial support from the state and pursuing the establishment of a national scientific community.

Nanna Katrine Lüders KAALUND | York University, Canada

A frosty disagreement: James Forbes and John Tyndall 's debate over glaciers as seen through the periodical press

In 1858, the Birmingham Daily Post published a summary of a lecture given by Mr W. Mathews Jr., on the 'Glaciers of Switzerland'. According to the article, Mathews' lecture had discussed the existing theories regarding glacial motion, and argued that the theory of John Tyndall and Thomas Huxley which build upon a series of observations by Faraday was better than the proposed theory of Professor James Forbes called the 'Viscous Theory'. This article in the Birmingham Daily Post was representative of a larger debate within the periodical press. The topic of glacial motion received a significant amount of press coverage in Britain in the years that followed. With the publication of John Tyndall's *Glaciers of the Alps* (1860), the disagreements between Tyndall and Forbes took centre stage. Building upon recent Tyndall scholarship and the vast historiography of periodical studies and environmental history, this paper will show how the dispute between Tyndall and Forbes was represented

in the British periodical press. One of the main points that I will demonstrate in this paper is the importance of taking into consideration the reading audiences in the formation and institutionalization of science. This builds upon the work of Jonathan Topham and James Secord; in addition to books such as *Science Serialized* (2004), *Science in the Nineteenth-Century Periodical* (2004) and *Culture and Science in the Nineteenth-Century Media* (2004) where the dissemination of science through the periodical press is examined. It also connects to Graeme Gooday and Katharine Anderson's work that has shown the complex interrelations between the development of physics and religion and politics, and the role different kinds of media (such as periodicals) play in promoting specific views on meteorology. This paper will take into consideration the contest for authority and expertise in relation to the debate between Forbes and Tyndall as it was manifested in the periodical press. In doing so, it will draw comparisons between the arguments put forth in Tyndall's own scholarship on glacial motion, and those examined in the periodical press.

Duygu AYSAL CIN | Bilkent University, Turkey

Science, technology and electricity in the Ottoman popular press, 1862-1914

This paper will provide a broad review for the accounts of electricity through the articles appeared in the Ottoman popular press from 1862 to 1914. Travelling between Ottoman periodicals by grasping electricity through their pages, the paper will mainly deal with the actual developments of electrification in several places of the Ottoman Empire and their presentation in the periodicals, circulation of scientific knowledge through the pages of journals and the accounts of experts, engineers and journalists regarding the electrical developments in the Empire. While the actual developments of electrification in several places of the Ottoman Empire could be traced from the Ottoman popular magazines and journals regarding the science urban issues; the way that the electricity presented in the Ottoman press as well as the accounts of scholarly electrical knowledge in the journals offers a good case regarding the communication of sciences targeted for the public at large in the Empire. In addition, the accounts of the experts and the engineers pertaining to the electrical developments helps to highlight the expert view about electricity as well as the ongoing huge infrastructural developments in the leading cities of the Empire, especially Istanbul. The negative critiques held by some of the journalists especially in the early 20th century for the urban change, for instance the critiques around electrified trams destroying a public garden or the historical buildings on their way or the positive critiques on the easy transportation provided by the electrified trams, all show different reactions for the technological change going on in the Empire. Regarding the sources of this paper, the periodicals published in the Ottoman Empire (1862-1914) in Ottoman Turkish, French and English will be used. The date 1862 stands for the publishing of *Mecmua-i Fünûn*; being the first popular science journal of the Ottoman Empire and the year 1914 stands for the opening date of Istanbul's first electrical plant.

Isabel ZILHÃO | Centro Interuniversitário de História das Ciências e da Tecnologia, Portugal

Science for children in the Portuguese daily press, 1924-1933

Children are the future citizens of a nation and a preferred medium for imprinting and consolidating new social and political paradigms. By studying the literature delivered to them at a certain historical period, we are able to pinpoint the values that society (or its elite) is willing to pass on to its future generation. The magazine *Notícias Miudinho* (News for Youngsters), printed at the bottom of pages of the nationwide daily newspaper *Diário de Notícias* (Daily News) and covering a wide variety of topics, is one such case, offering a fresco of Portuguese society between 1924 and 1933. The period comprises the last two years of the First Portuguese Republic (1910-1926) followed by six years of a military dictatorship, when by 1933 the dictator António de Oliveira Salazar

managed to impose himself to competing adversaries. A much impoverished *Notícias Miudinho* ended also in 1933.

Notícias Miudinho stems from the educational movement for all set in motion by the Republican elite in order to increase the literacy level of the population (24% in 1910). It was divided in sections fundamentally comprising stories, squibs, boy scouting, history and chorography, household management and, of course, science. Science dedicated sections included descriptions of experiments based on everyday life to illustrate physical phenomena accompanied by illustrative drawings, as well as more articulated articles explaining scientific fact and describing the industrial production of goods. Hygiene and physical health advice were also present. *Notícias Miudinho* appeared even as *Diário de Notícias* reported on the discussions running amongst the Portuguese elite about the future of the Portuguese industry and agriculture, and on how technical teaching should be implemented to cope with the necessities of modern industry and commerce. All accompanied by the exaltation of the Portuguese race headed by sanctified historical figures.

Based on a comprehensive survey of articles popularizing science, technology and health topics printed in *Notícias Miudinho* from 1924 to 1933, I intend to show how they tuned with the on-going Portuguese political agenda. If by 1924 *Notícias Miudinho* mirrored the “National Rebirth” ideology dominating Portuguese society, it progressively adjusted to the ensuing simplifications of the official educational program promoted by the military after 1926.

On one hand, I intend to discuss how the study of the transmission of scientific and technological knowledge through the press can shed light on the techno-scientific construction of societies. On the other hand, as *Notícias Miudinho* contains the seed for right-wing and fascist oriented politics that will appear in Portugal as well as in other European countries, it would be interesting to understand if *Notícias Miudinho* is unique among these countries.

S075-C. Why publish?

Mon 22 July, 16:00–17:30 • Uni Place 3.204

Chair: Eirini MERGOUPI-SAVAIDOU | National and Kapodistrian University of Athens, Greece

Jo ELCOAT | University of Leeds, United Kingdom

‘For the use of schools’: The emergence of a scientific schoolbook market in eighteenth-century England

The second half of the eighteenth century witnessed rapid expansion in the number of private schools. Many of these schools offered a new modern curriculum incorporating mercantile topics and modern languages and increasingly including scientific subjects. This paper argues that in responding to these developments booksellers, in combination with authors, began for the first time to shape a scientific schoolbook market.

The paper begins by examining how, from mid-century, booksellers began increasingly to distinguish schoolbooks from other didactic scientific publications. I consider advertisements and reviews, as well as the content of the books, to demonstrate how books “for the use of schools” became increasingly differentiated from public lecture companion texts and works of polite science for use in the home. In particular I argue that claims to pedagogic expertise, made by both publishers and authors, contributed to these processes by creating new styles of presentation as well shifts in subject coverage. While the process of generic differentiation continued into the nineteenth century, a number of schoolbook booksellers were well placed by the 1790s to exploit the explosion in schooling that took place in the early nineteenth century.

In the second half of the paper, I outline trends in scientific schoolbook production in the eighteenth century, including periods of growth, shifts

in the locations of publication and the rise and fall of leading individuals in the schoolbook business. I describe how a small, metropolitan writing, printing and bookselling milieu was gradually supplanted by a larger, mixed provincial and metropolitan marketplace from the 1750s. This diverse marketplace itself was again transformed as a rapid increase in production in the 1790s led to the eventual dominance of the schoolbook market by a small number of booksellers. I conclude by arguing that these changes in the scientific schoolbook market, particularly when placed alongside similar trends in medical publishing, scientific publishing for university students and educational publishing more widely, enable us to identify leading scientific publishers who through their dominance had the power to shape the curriculum.

Alper YALCINKAYA | Ohio Wesleyan University, United States

Publisher, teacher, father: Ahmed Midhat and the popularization of science in the nineteenth-century Ottoman Empire

One of the liveliest debates in the late 19th century Ottoman Empire was about the boundaries, benefits and potential dangers of the new sciences of the Europeans – the sciences that the Empire had been adopting. What made this debate possible was the emergence of the Ottoman-language press and the birth of print capitalism in the 1860s. The growth of the press and the appropriation of the European sciences were parallel and closely connected processes in the Ottoman Empire of the 19th century. Thus it is not surprising that the symbol of print capitalism in the Ottoman Empire also played a key role in the construction of a discourse on science and scientists, and – to a considerable extent – became the symbol of science itself. In this paper, I analyze the work and significance of this man, Ahmed Midhat Efendi (1844-1912). Primarily an autodidact, Midhat had a uniquely successful career as a journalist, novelist, and publisher of newspapers and books. In the hundreds of essays and books (both non-fiction and fiction) that he published, Midhat aimed at what he regarded as disseminating “useful knowledge” and making the Ottoman people aware of matters of which it was ignorant. In his long career he also transformed himself from a writer of “controversial” essays on evolution and materialism into an ally of the Sultan, an advocate of the *raison d'état*, and a critic of “over-westernization.” The meaning of science and the role of scientists was one of Midhat’s favorite topics. In a society where the “new sciences” had not yet been institutionalized and evolved into a true career path, the contribution of his endless writings to the emergence of a dominant Ottoman discourse on science was matchless. At a time of severe censorship, the newspapers he published constituted the space within which the Ottoman debate on science took place, and to many young Ottoman students of science, Midhat was the person to communicate with, if not to consult – even on scientific issues. In this respect, Ahmed Midhat’s position not only blurs the line between “popularizer” and “scientist” but also helps us place “science” within its specific social, political, and ideological context. Midhat himself was aware of this, as he frequently wrote on his own role. His very complaints about the general lack of specialization and professionalization in the Empire that put “too big a responsibility” on him and made him the “headteacher of the nation” demonstrate unmistakably what else is at stake in definitions of and discussions on science.

Imogen CLARKE | Independent scholar, United Kingdom

Relationships of trust and positions of influence: promoting ‘modern’ physics in the professional and public realms of 1920s Britain

The early twentieth century was a period of dramatic change in physics, as Newtonian mechanics was challenged by the new theories of relativity and the quantum. While we now describe the former as classical and the latter as modern physics, these categories were not self-evident. Even as late as the 1920s, there were not clear definitions of ‘classical’ and ‘modern’ physics, and there was no consensus as to the place of the former in the future of the discipline. In this paper, I

explore how British physicists managed the transition from 'classical' to 'modern' through their scientific and 'public' publications in the 1920s. I consider the physicists responsible for managing the Royal Society's Proceedings, and look at how they made judgements over what counted as a 'valuable' scientific contribution. Central to their assessments of a paper's suitability for publication was its incorporation of what they defined as 'modern' physics, with 'classical' offerings often deemed unhelpful to the progress of physics. In contrast, the editors of the Philosophical Magazine welcomed 'classical' physics, and the journal served as a home for many papers that the Proceedings would not publish. In the 'public' sphere, meanwhile, the worth of 'classical' physics was promoted almost unanimously in positive terms. In their popular books, physicists who engaged with wider audiences were careful to portray 'classical' and 'modern' physics as working in harmony, denying any claims of a 'destructive' revolution or new theories having superseded the work of Newton. This public reverence towards Newton, and attempts to rescue 'classical' physics from disrepute, was part of an effort to present the discipline as stable and consequently trustworthy. I analyse the work of two physicists in particular: Oliver Lodge and James Jeans. The case of Jeans provides a clear example of the contrast between 'public' and 'professional' evaluations of 'classical' physics. As Physical Secretary of the Royal Society throughout the 1920s, Jeans rejected papers that were not sufficiently 'modern', but in his public pronouncements he emphasised the continuing importance of Newtonian mechanics. Oliver Lodge, staunch defender of the ether, was an editor of the Philosophical Magazine, and encouraged the type of physics dismissed by Jeans. In Lodge's popular books and articles, he depicted physics as being in a state of transition, awaiting a 'Newton' that would connect the 'classical' to the 'modern'. In both of these cases, issues of trust and expertise are important. Both Jeans and Lodge had trusted contributors, whose work they would publish without question. And in the 'public' sphere, Jeans and Lodge acquired the reputation of 'experts', trusted to teach the public about physics. Relationships of trust directed the publication of 'classical' and 'modern' physics throughout the 1920s, revealing a continuity between professional and 'popular' publishing. While the content of 'popular' physics might differ considerably from that published in the Proceedings, both were influenced by similar forces.

Viviane QUIRKE | Oxford Brookes University, United Kingdom

Patent or publish?: ICI Pharmaceuticals' publication strategy in historical perspective

Nowadays, the productivity of pharmaceutical companies can be measured by counting their publications. The empirical findings derived from such bibliometric analyses can then be used to reach conclusions about the state of the industry as a whole, as was done recently in a study of 'Big Pharma's R&D decline'. However, this was not always the case. At the beginning of the 20th century drug companies were still commonly described as 'pill peddlers' and publications rarely featured among their products, which were usually branded as 'patent medicines'. While secrecy dominated these producers' activities, which remained associated in the popular imagination with 'quack remedies', a new group of firms, the 'ethical' drug makers, sought to distance themselves from their competitors. Even though patenting continued to occupy a central role in their business activity, research, and with it publications, soon came to distinguish them from their rivals on the medical marketplace. Yet, in the last decades of the 20th century, when private companies had in that sense become more 'academic', public research institutions were increasingly being encouraged to patent their discoveries.

In this paper, I will give an overview of this transformation, which has seen the public and private sectors converge in terms of their research and publication strategies, but which has largely been ignored by historians of the pharmaceutical industry, who have tended to focus on firms' patenting activities, while historians of science have been more interested in the publications emanating from public research institutions. Through the detailed case study of Imperial Chemical Industries (the

'flagship' of British chemical-pharmaceutical industry after World War Two), I will analyse the publication strategy of a particular British drug company, and will explore the extent to which this strategy was linked to the firm's scientific/technical background rather than its national origin. I will then analyse the types of publication produced: not only research papers with multiple authors, but also single-authored training manuals for a wide circulation (e.g. on the use of statistics in industry), by which certain research practices were transferred from sector to sector, and models of industrial R&D were disseminated nationally and beyond. I will link what could be described as the firm's open publication culture to the popularisation activities carried out by some of its researchers, in particular Stephen Carter, who after leaving ICI in 1981 created one of the world's first micrariums in Buxton, Derbyshire. The paper will end by examining the rationale behind such activities and publications, and the tensions that often arose around them between the scientific and commercial agendas of firms, which made the transformation alluded to earlier neither a linear, nor an uncontested one.

S076. Theology at work in science / Science at work in theology

Wed 24 July, 14:00–17:30 ▪ Roscoe 1.007

Symposium organisers:

John C HENRY | University of Edinburgh, United Kingdom
Stephen PUMFREY (non-participant) | Lancaster University, United Kingdom

Symposium abstract

Many devout natural philosophers in early modern Europe insisted upon a rhetoric of keeping science and religion separate, and yet these same philosophers failed to do this in practice and often put their theological assumptions to work in making claims about nature, or they put their 'scientific' ideas to work in developing their theological positions. Newton's theology, for example, informed his concept of absolute space; while Thomas Hobbes's commitment to materialism forced him to develop an extremely heterodox theology. This symposium will consider a number of such cases with a view to enhancing our understanding of the relations between science and religion in the early modern period. One major case study, being developed jointly by the organisers, will show how the theological concept of 'experimental knowledge' was appropriated in England by natural philosophers and put to work in developing a new method for discovering natural knowledge.

S076-A

Wed 24 July, 14:00–15:30 ▪ Roscoe 1.007

Chair: John C HENRY | University of Edinburgh, United Kingdom

Discussion

Peter Harrison and Steven Pumfrey have both had to withdraw from this session which was to begin with a discussion of Harrison's recent *Experimental Religion and Experimental Science in Early Modern England* (2011). John Henry will begin by explaining what they would have said had they been here, before making his own contribution to this debate.

John C HENRY | University of Edinburgh, United Kingdom

Experimental religion and experimental science in early-modern England, part 2

This presentation offers some considerations arising from the empirical results of Stephen Pumfrey's corpus-linguistic analysis of the use of 'experimental' and 'experiment' in early modern printed sources. Broadly, the research confirms Peter Harrison's recent claim that these terms were current in religious and theological literature, before appearing in works concerned with the study of the natural world. But the picture is more complex than Harrison allows, and those complexities raise problems which he did not consider. In particular, Harrison does not notice that usage of these terms strongly suggests an association with radical sectarian views—those views decried as 'enthusiastic' by more mainstream thinkers. Consequently, there is a dramatic falling off of talk of experimental religion in the 1660s at just the point when 'experimental' is taken up by natural philosophers. Immediately, this raises the question as to how experimental philosophers avoided charges that their experimental philosophies must be tainted with the same kind of 'enthusiasm' as seen in the experimental religionists. An obvious response to this is for the historian to suggest that previous, and on-going, scholarship on the origins of the experimental method (from Roger Bacon to Francis Bacon) shows that the term 'experimental' must have had a separate and well-understood significance which enabled readers in the 1660s to recognise that natural philosophers were using the term in this sense, rather than in the potentially subversive sense of the religious 'enthusiasts'. But, if the terms 'experiment' and 'experimental' had this separate, parallel, usage in natural philosophy and related traditions (natural magic, mathematics, and medicine), why do they not show up in corpus-linguistic surveys? Furthermore, we can turn this around and ask what are the implications of the lack of usage of 'experiment' and 'experimental' in natural philosophy before the 1660s for scholarship in the history of science, which has traced the origins of the experimental method back to Francis Bacon and even earlier? The presentation will address these and other problems arising from this corpus-linguistic research, and may even offer some tentative answers.

Sorana CORNEANU | University of Bucharest, Romania

Medical uses of the immortality of the soul in the late Renaissance

Renaissance medical thought was largely indebted to a Galenic tradition whose tendency had been to look at the soul only insofar as the effects of the body's humors and spirits on its faculties could be established. This ultimately materialist tendency was nevertheless sometimes accompanied by a specific, and apparently incongruous, use of the immortal soul and its faculties in works by late Renaissance physicians. This paper looks at several such works relevant for the English context of the time – by Dutch physician Levinus Lemnius, whose *Occulta naturae miracula* (1559) was known in England in the late sixteenth century, as was his *Sanctuarie of Salvation*, translated in 1592; and two works on melancholy by English physicians: Timothy Bright's *Treatise of Melancholie* (1586) and Thomas Walkington's *The Opticke Glasse of Humours* (1607) – and asks: what exactly is the use they make of the immortal soul in a medical context? Is this a case of an uneasy conjunction of scientific-medical and theological-philosophical agendas? The suggestion I would like to make is that the theological-philosophical theme of the immortal soul is appropriated in these works in order to serve a medical purpose: understood as a source of activity in its own right, independent of the body, although necessarily using it as an instrument and also interacting with its activity in multifarious ways, the soul could be established as an object of medical care. Such care would be the province of an integrated medicine, of the body as well as of the soul and, ultimately, of the vital union of body and soul. The paper considers the conceptual ingredients of this view and their transmission, as well as the issues of disciplinary and institutional re-configuration it expressed. It is also aimed as a contribution to current discussions of the early modern 'medicine of the mind': the trend I am investigating here may be seen as occupying an intermediary conceptual and disciplinary space between the moral-religious care of the soul and the medical-determinist view – epitomized in the late Renaissance by Juan Huarte's

Examen de ingenios (1575), known in England as *The Examination of Wits* (1594) – of the corporeal regimen of the mind.

Carolyn DOUGHERTY | University of York, United Kingdom

Purity and efficacy

In this paper I consider how alchemists, early modern natural philosophers, contemporary scientists, and the established Church (Roman Catholic and Anglican) express the relationship between such personal character traits as purity and good intent and the efficacy of an individual's experiments or actions. Both Catholic and Anglican doctrine explicitly state that the efficacy of a sacrament does not depend on the personal attributes of the priest who performs it; this doctrine contrasts with the writings of many early modern alchemists and natural philosophers who argue that the success of an experiment or the efficacy of an action depend at least in part on the personal characteristics of the experimenter or actor. In this respect, the contemporary description of the scientific method is more consistent with the view of the Church than with that of early modern natural philosophers. Similarities between the views of the Church and of the modern scientific establishment appear to arise from similarity in institutional structures, the role of individuals within large and complex organisations, and understanding of the relationship between the individual and the institution; in this respect the established Church and the modern scientific establishment have more in common with each other than with the early modern network of researchers that we traditionally consider the predecessor of the modern scientific establishment. A consideration of these differing views of the effect of personal traits on experimental efficacy can help us develop a better understanding of how we have come to differentiate between 'arts' and 'sciences', the distinctive nature of craft knowledge, and the relationship between employer and employee in capitalist economies.

S076-B

Wed 24 July, 16:00–17:30 ▪ Roscoe 1.007

Chair: Sophie WEEKS | University of York, United Kingdom

Ignacio A. SILVA | University of Oxford, United Kingdom

The 'laws of nature' and the Eucharist in a sixteenth-century controversy

The influence of Cartesian philosophy both in England and in France, together with the funding of the Royal Society and the Académie des Sciences, facilitated a considerable rise in the use of the term 'law of nature' during the seventeenth century. Such laws, referring to natural phenomena rather than to the moral order, were first posited by Descartes as explanatory devices to account for many of the divergent facets of nature. Much has been said about the development of this notion, its intellectual and philosophical lineage having been traced from medieval mathematical rules and theological discussions about divine power to sociological features of late-Renaissance monarchical governance. A great deal of scholarship has, furthermore, been devoted to the characterisation of this notion as something imposed by God, explanatory of nature's regular behaviours, and capable of expression in mathematical terms.

On the other hand, not much research has been directed to understanding the uses to which this term was employed in previous centuries. This paper will address an instance in the late sixteenth century, in which a circumscribed group of scholars engaged in a theological discussion used this very terminology. Discussing the real presence of the body of Christ in the Eucharist and related issues, Robert Bruce (1554-1631), moderator of the General Assembly of the Church of Scotland, Catholic theologian William Rainolds (1544-1594), and Cambridge professor of divinity William Whitaker (1548-1595) employed the metaphor 'laws of nature' in a post-Scholastic framework as divine mandates, assuming them to have an explanatory rôle for both the ways of nature and of God. The terminology they included in their

discussion ranged from 'laws of nature' and 'of physics' to 'laws of God' and 'of theology', always referring to laws regulating nature itself. Even though this terminology was not widespread, the locations and contexts in which it was used are significant for understanding its future ideational development. The thesis I intend to suggest is that these uses present an instance when this expression was employed – at least from the late-sixteenth century – as a theological explanatory device which later shifted to the realm of natural philosophy. I will also suggest that even though the notion existed in previous centuries, the contexts of natural philosophy were not amenable enough to accept it, while the theological grounds were more receptive for its use.

Silvia MANZO | National University of La Plata, Argentina

Laws of nature and God in Francis Bacon

Francis Bacon's natural philosophy allows distinguishing two sorts of entities labeled "laws of nature". On the one hand, Bacon talks of the "summary law of nature" that is a sole law of the highest generality. The summary law of nature sometimes is identified with the "primary atomic motion", while it is as well described as "the work which God worked from the beginning to the end", or even as the "highest generality of motion". On the other hand, Bacon refers to the "leges fundamentales communes naturae" or "leges actus puri". They are understood as general regularities and are identified with "forms" or formal causes.

Besides, Bacon distinguishes two "styles" of God's work during the creation of the world: the "style of manufacture", which represents his power; and the "style of law, decree or counsel", which represents his wisdom. This "double emanation" of God's creative action is particularly apparent in the description of the stages of nature as described in *A Confession of Faith* (1602), where Bacon defines nature as the constant and eternal laws imposed by God at the creation. These laws, we are told, have undergone three states: i) the stage when the matter of heaven and earth existed without forms; ii) the stage when during the six days of creation all natural species were created; iii) the stage beginning with the Fall of Adam and including our own. The fourth and last stage is to take place at the end of the world.

Whereas Bacon doubts that human mind could grasp the summary law of nature, he contends that forms or particular laws of nature are the subject matter of metaphysics, whose knowledge should be achieved by inductive method. As parts of natural philosophy, metaphysics along with physics are devoted to interpret the "book of nature" by which God manifests his power. The Bible, instead, is the book by which he reveals his will.

Following the lead of the recent debate on voluntarism and the origins of early modern science (Harrison, 2002, 2009; Henry, 2009) this paper will explore the theological assumptions underlying Bacon's characterization of laws of nature, in order to find out whether or not it is possible to ascribe to him a voluntarist or an intellectualist stance.

James A. T. LANCASTER | Warburg Institute, United Kingdom

Reconsidering the natural and moral orders: *lumen* and *leges naturae* in the thought of Francis Bacon

The configuration of the world, at least prior to the Fall, explained Bacon in his *De principiis*, 'was the best of which matter (as it had been created) was susceptible'. Employing the light of natural reason with which he had been endowed, Adam had been able to perceive the essential natures of God's creation and bestow upon each species its own unique name. But this was not all: Bacon, in fact, suggested elsewhere that the prelapsarian may even have been able to perceive—likewise through the use of his natural reason—the *moral* fabric of the universe. Here, two sides of the same coin become evident: the moral dimension of nature, on the one hand; and the capacity of man to recognize it, on the other.

In the initial instance, it is telling that, when Adam and Eve transgressed the moral law, the order of nature itself degenerated. As curious as it may be, it should be remembered that the Bible, even if only metaphorically, had situated the definitive knowledge of good and evil within a tree. The possibility that Bacon identified the *lex moralis*—at least to some degree—with the *leges naturae*, should thus not be overlooked. For, even some of his earliest works, such as *Of the Colours of Good and Evil* (1597), suggest that a 'universal knowledge of the nature of things' alone was sufficient to guarantee the verity of moral judgments. There are numerous other instances scattered throughout Bacon's more mature writings that likewise hint at a close identification of the moral with the natural orders.

Where a recognition of good and evil was concerned, Bacon argued that, in his once 'pristine and primitive purity,' man had possessed a certain natural capacity whereby he could perceive the 'colours' of morality. Yet, of this capacity—man's 'light of nature'—there now remained only 'a sparkle of [that] puritie of his first Estate'. Bacon referred to this 'relic' as a certain 'instinct'; a universal motion or appetite of material nature towards the good. He employed the term *lumen naturae*, then, in at least two senses: foremost, as man's natural reason, but also as nature's own intelligence (as residing in its *percipio* and *appetitus*). As a result, even nature's light had once been able to recognize the double nature of the good.

It is to this somewhat complex union of the moral and the natural orders in Bacon's philosophy that this paper thus proposes to attend; to offer a working thesis through the provision of a clarification of Bacon's thought on this issue.

S077. Transnational nuclear perspectives

Sat 27 July, 09:00–17:30 • Uni Place 1.218

Symposium organisers:

Jonathan HOGG | University of Liverpool, United Kingdom
Maria RENTETZI (non-participant) | National Technical University of Athens, Greece

Symposium abstract

This symposium brings together nuclear scholars from disparate research backgrounds to explore 'transnational nuclear perspectives'. The symposium will have four panels across one day. Chaired by Jeff Hughes, the first panel will explore 'Nuclear Activism'. Three papers by Alison Kraft, Silke Fengler and Christoph Laucht will examine 'scientific activism' and transnational scientific-political networks.

The second panel, 'Nuclear Industry', chaired by Jacob Hamblin, will present new research on the development of nuclear industries in Europe. Maja Fjaestad explores the unique characteristics of the Swedish nuclear industry. Mar Rubio will explore the development of nuclear science in Spain, and Christian Forstner looks at how the history of Austria's nuclear development can be viewed in a comparative perspective in the Cold War context. Finally, a paper by Karena Kalmbach analyses national political responses to Chernobyl.

The third panel, entitled 'Nuclear Narratives', is chaired by Christoph Laucht. Dan Cordle will present a paper on the national and international dynamics of nuclear discourse. Bo Jacobs and Mick Broderick will present their recent research on global nuclear testing, before Jonathan Hogg asks whether the conceptualisation of nuclear anxiety can be developed further.

The last panel of the day is entitled 'Nuclear Cultures', chaired by Joseph Masco. Ele Carpenter explain how her curatorial work on dismantling nuclear submarines is attempting to 'map the conceptual

scope of the nuclear field'. Richard Maguire will then discuss his research on nuclear decision making, applying theories of behavioural psychology to complex professional networks. The last paper of the day will be presented by Dan Grausam, whose latest research interests are focused on the 'strategies in recent installation art, collage, photography and literature for making radioactive danger visible'.

Joseph Masco will then offer a commentary on the final panel, with time for questions for the final panelists and a general discussion on themes explored as part of the symposium. It is hoped that the transnational focus of the symposium will encourage exploration of 'how facts, and other knowledge-claims, travel between disciplines, countries and communities' as well as advance our understanding of 'relationships between those knowledge-making enterprises which are described as 'science' and those which are not, and the dynamics of the boundaries between them.

S077-A

Sat 27 July, 09:00–10:30 • Uni Place 1.218

Chair: Jeff HUGHES | University of Manchester, United Kingdom

Alison KRAFT | University of Nottingham, United Kingdom

Pugwash and the 'fallout' issue in the early Cold War: a case study of transnational scientific activism

After the Second World War physics enjoyed a new found status and authority born of its vital role in the nuclear enterprise and its importance for national defence. For some physicists, however, the close association of their discipline with nuclear weapons and the commitment of governments to the development of nuclear weapons engendered deep dilemmas of conscience. This followed in the wake of unease amongst scientists internationally about the use of nuclear bombs against Japan in 1945, and amid mounting concerns in the 1950s about nuclear weapons proliferation and intensifying programmes of nuclear bomb testing. This paper focuses on the problem of 'fallout' from nuclear bomb tests as this became the subject of highly charged political debate, bringing the dangers of ionising radiation - leukaemia and genetic damage - sharply into focus. Fallout was an integral part of the nuclear age and Cold War politics, and was also important in the development of a new environmental consciousness. It remains, however, under-explored and poorly understood. This paper seeks to contribute new understanding of the fallout issue.

Organized into three parts, the paper begins by highlighting divisions amongst scientists on the dangers of fallout, examined here through the different responses of British scientists to the 'fallout' problem. Secondly, it emphasizes 'fallout' as a key animating force in the inception of the Pugwash movement in 1957. The Pugwash Conferences on Science and World Affairs sought to further the principles, values and aims set out in the Russell-Einstein manifesto of July 1955 which called for an end to nuclear weapons, the arms race and nuclear bomb tests. Thirdly, the paper analyses the unique role of Pugwash as a transnational actor which sought both to shape policy on testing and fallout, and inform the public about this problem. It argues the significance of Pugwash for scientists as a distinctive form of activism and as a means to express their sense of social responsibility. The paper concludes with some reflections on the fallout issue as a site to explore the sometimes fraught relationships within the scientific community in the 'atomic age' and between scientists and the state in the early Cold War.

Silke FENGLER | University of Vienna, Austria

'Experts between war and peace': Austrian scientists and the international Pugwash movement

Securing peace during the Cold War was a task that no nation state could handle alone. Whereas the international community of states tried to establish a binding arms control system, a number of civilian groups also took the initiative to fight against the threat of nuclear war. Among these groups, the Pugwash Movement is one of the most prominent. Its founding manifesto, elaborated by British and American nuclear scientists in 1957, called for their colleagues around the world to take a stand for nuclear disarmament. The Pugwash Movement created a new type of civilian involvement which oscillated between the elitist claim of academic expertise and the search for integration into the peace movement.

The proposed paper addresses the history of the Pugwash movement by taking the example of Austria. Covering a period of investigation from the mid-1950s to the early 1980s, the paper raises two important questions: Firstly, it investigates into Austrian scientists' Pugwash-related activities between the poles of scientific internationalism, Austria's policy of neutrality, and the policy of confrontation: How did the country's reintegration into international scientific co-operations (e.g. CERN) foster the cross-linking of Austrian Pugwashites with the transnational movement? How and why did Austria, a peripheral country in terms of nuclear politics and yet at the heart of Cold War confrontation in Europe, become a platform for the transnational scientific-political dialogue within the Pugwash framework? Secondly, the paper examines the role of scientists as policy advisers to the Austrian government: How did their international cross-linking qualify Austrian experts as political consultants at home? Moreover, did Austrian Pugwashites manage to introduce domestic positions on the international Pugwash agenda?

Christoph LAUCHT | University of Leeds, United Kingdom

The moral economies of transnational professional activism against nuclear weapons in Cold War Britain

Protests against nuclear weapons in Britain and elsewhere during the Cold War have by and large been examined as part of the peace movement. This paper, by contrast, offers a novel approach to anti-nuclear-weapons protests by viewing them as a form of professional activism. It focuses on two key British professional organizations – the Atomic Scientists' Association (ASA) and the Medical Campaign against Nuclear Weapons (MCANW) – during two pivotal moments of the Cold War.

Shortly after the atomic bombings of Hiroshima and Nagasaki, British nuclear scientists who had by and large participated in the creation of the first atomic bombs founded the ASA out of the social responsibility that they felt was emerging from their wartime work. The ASA represented the British counterpart of the Federation of American Scientists (FAS) – perhaps the best-known organization of the atomic scientists' movement. In 1980, during the so-called Second Cold War that was characterized by a renewed intensification of fears of nuclear war, British medical professionals – above all, physicians – founded the MCANW based on their professional ethos to help all mankind under the Hippocratic Oath.

The paper examines the two organizations' 'moral economies', which constitute, according to Janet Atkinson-Grosjean and Cory Fairley's broad definition, 'systems of shared values, traditions, and conventions about ways of doing, being, knowing, and exchange' that 'are expressions of the moral communities that hold them' with regard to the ASA's and the MCANW's anti-nuclear-arms activism. Particular attention will also be paid to claims to expertise and expert knowledge by members of these two groups. For heuristic purposes, the paper focuses on the ASA's promotion of the international control of atomic energy to prevent a nuclear arms race in the immediate postwar period and the MCANW's treatment of the medical consequences of atomic war in the early 1980s.

Since the two professional bodies formed part of larger, transnational networks, the paper analyses their campaigns within the transnational

context of professional antinuclear- weapons activism to demonstrate how professional activism during the Cold War was played out on a national level and reach conclusions about its broader and nationally distinctive cultural and social impacts. In the case of the ASA, it will offer comparisons with FAS policies on and communication between the American and British sister organizations on international control. As the MCANW became the British affiliate of the transnational network International Physicians for the Prevention of a Nuclear War (IPPNW), the paper will compare and contrast the MCANW's take on the medical effects of nuclear war with that by the US-based umbrella organization as well as the West German IPPNW section.

S077-B

Sat 27 July, 11:00–12:30 ▪ Uni Place 1.218

Chair: Jacob HAMBLIN | Oregon State University, United States

Maja FJAESTAD | Royal Institute of Technology, Stockholm, Sweden

The geopolitics of uranium: Swedish energy dependencies from a transnational perspective

A metaphor that is often used to describe energy supply is that of a nation's blood circulation. Indeed, a permanent interruption in the supply of energy would be lethal to any society. Sweden – a neutral country in cold war Europe – belongs to those countries that are, and have been, very strongly dependent on imports of energy, and this implies a special vulnerability. Today two imported energy carriers – oil and uranium – each covers some 30 % of the total.

Sweden is of course not alone in its dependence on imported fuels. The world's energy resources are unevenly distributed, and since the mid 19th century the pursuit of coal, oil, gas and uranium has been an important constituent of international politics and economics.

Transnational fuel dependencies have a politics of their own: the strongest nations have used economical, political and if necessary military means to control energy sources in far away territories in order to secure their energy supplies at home. This is often referred to as the *geopolitics of energy*, and there has been quite some research about it. There has been less research on how *small* nations have tried to handle their dependencies on far away countries using “soft” means rather than “hard” ones. By studying how Sweden has done this we hope to contribute to an understanding of the geopolitics of energy of small nations.

This paper is a part of a larger research project (together with prof Arne Kaijser and Dr Per Högselius) where we investigate Sweden's strategies for coping with the dependencies on energy from abroad. My case study in the project will investigate the role of uranium import in Sweden.

In the 1940s and 50s, Sweden planned to develop a domestic nuclear energy system based on Swedish uranium. However, this autarky policy was abandoned in the mid-1960s for economic reasons, and the Swedish power industry decided to build light water reactors and import enriched uranium from the United States. In 1966, the Swedish Government signed a 30 year agreement with the United States concerning the purchase of enriched uranium. On the Swedish side, the imports of uranium were orchestrated by the Swedish Nuclear Fuel Supply company, SKBF, owned jointly by the major Swedish power companies. But a high ranking civil servant was made president of the board; a sign of the political influence on the company.

Uranium imports had multiple steps and required contracts not only for uranium ore, but also for the conversion and enrichment. In the 1970s and 80s there was a gradual shift to purchasing uranium ore primarily from non-nuclear weapon states. And when it comes to enrichment, the initial dependency on the US was decreased by enrichment contracts with the joint European companies Eurodif and Urenco and with the

Soviet company Techsnabexport. A central question is to what extent security policy considerations affected these changes.

In 1984, SKBF changed name to SKB and changed its focus from ensuring nuclear fuel to handling nuclear waste, and uranium imports became the responsibility of the reactor owning power companies. I will discuss this tension between private and state initiative in Swedish nuclear fuel policy and why this balance has changed over time.

I will focus on which actors and which motives have been central in these decisions and whether it is possible to identify a distinct but evolving ‘**Swedish model**’ in actors' attempts to deal with vulnerabilities stemming from energy import dependence, and if this model has applied to the energy system as a whole, i.e. the same model has applied to all types of fuels. My analysis will be based on a LTS-perspective.

Mar RUBIO | Universidad Pública de Navarra, Spain

State involvement in the development of nuclear power in Spain, 1960s-1980s

The development and survival of nuclear power around the world has only been possible thanks to the support of the state. State involvement with civil nuclear uses goes back to the dawn of the industry and continues today. It is not just a mere financial contribution. It includes the creation of new institutions and industrial firms, the elaboration of specific laws and special tax regimes, training people, supplying materials and storing nuclear waste. There are so many ways in which the State contributed to build, run and close nuclear power plants, that no effort has ever been made to carefully identify them and quantify them. This is a first attempt to identify and quantify the State involvement in the development of nuclear power in Spain from its beginning to the moratorium in 1983.

In order to complete the map, we have looked for sources beyond our borders. The technological and economic transfers involved, required negotiations at the state level, mostly, but not only, with the two nuclear leaders: the USA and France. Both of which had their own state web supporting nuclear power. Within Spanish borders, we have used Government and industry reports as well as secondary sources. The result is a comprehensive atlas of State involvement in the development of nuclear power in Spain from 1960s-1980s, which will help to understand more accurately the actual size, costs and benefits of the sector.

This presentation is based on work co-authored by Joseba de la Torre.

Christian FORSTNER | Friedrich-Schiller-Universität Jena, Germany

Nuclear fission and Austria's integration with the West

The entanglement of physical research with government, politics and industry as well as the public negotiation of science, reached a qualitative new dimension during the Cold War. To draw a “big picture”, which includes all aspects of this process in its entirety without reducing its complexity, is only possible with a clearly defined analytical item. Therefore an exemplary investigation of nuclear research in Austria during the second half of the 20th century will be conducted in form of an analysis, which equally traces the historic development of the discipline as well as its social, cultural and political background.

As a small politically neutral state in the Cold War, the characteristics of this process are significantly more pronounced in Austria than other countries. First, the interdependence of national research programs with transnational organizations as the *International Atomic Energy Agency*, which is based in Vienna, second, new research concepts beyond academic laboratory science, which lead to new interaction examples between government, science, industry and society and third, major technologies that have been subject to new social evaluation criteria up to now. These emerging structures can be traced in the defined

framework of Austria in a detailed manner, ranging up to the establishment of a national nuclear energy program.

As John Krige pointed out, a transnational network with the United States as a hegemonic junction was dominant at the beginning of the Cold War, but the smaller inner European networks experienced an upward revaluation in comparison to the transatlantic networks within the scope of the construction of Austria's first nuclear plant at the end of the 1960s. The completed nuclear plant in Zwentendorf however, never became operational due to a public vote in 1978. All further nuclear energy projects were frozen. Today, Zwentendorf is still a central place of remembrance of the Austrian ecology movement.

In order to draw an integrated picture however, the Austrian development cannot stand alone. In a conclusive comparison with Danish and the West-German nuclear energy programs the analysis will be re-contextualized within the European framework and gives a clearer picture of the different nuclear energy policies of the national states, which also helps to understand the current situation of nuclear energy today.

Karena KALMBACH | European University Institute, Italy

The contested 'truth' about Chernobyl

I would like to present my work in progress on a comparative history of the French, Italian and British Chernobyl discourses, undertaken in the framework of my PhD at the European University Institute. By now, I have accomplished my case studies on France and Britain. In my paper, I would like to discuss conclusions drawn from my comparative work on France and Britain and perspectives for the approaching of the Italian case. My research deals with the question of how national nuclear politics have influenced the debate on the health effects of the accident in the respective countries (and vice versa) and how the commemoration of the accident has been used to underpin political arguments. At the same time, the comparative perspective applied sheds light on the importance of underlying structures such as risk perception, elite culture, and environmentalism as well as on the role of individual agency. These factors condition the emergence of a specific narrative of the accident within a specific discursive field and, furthermore, determine the meaning which is attributed to 'Chernobyl'. I pay special attention to the anniversaries of the accident in 1996 and 2006 because of the political implications that are tied to the commemoration of 'Chernobyl'. The case of 'Chernobyl' makes a particularly challenging research topic as the question 'What was (or is) Chernobyl?' directly impacts current questions regarding (nuclear) energy and environmental policies.

S077-C

Sat 27 July, 14:00–15:30 • Uni Place 1.218

Chair: Christoph LAUCHT | University of Leeds, United Kingdom

Daniel CORDLE | Nottingham Trent University, United Kingdom

Gone with the wind: transatlantic nuclear literature and culture in the 1980s

In a famous image, first published in 1980 in the British paper, *Socialist Worker*, a spoof film poster for *Gone with the Wind* depicts Ronald Reagan as Rhett Butler, with Margaret Thatcher, as Scarlett O'Hara, reclining submissively in his arms. A mushroom cloud billows in the background and the poster bills this version of *Gone with the Wind* as 'the film to end all films' and 'the most EXPLOSIVE love story ever.' Its tag line, running across the bottom of the poster, is: 'She promised to follow him to the end of the earth. He promised to organise it!'

The poster is illustrative of an important transatlantic dynamic in nuclear discourse during the 1980s. Revitalised as a pressing public concern by technological developments, new scientific models for understanding the ecological impact of nuclear war and more fraught relations between the

superpowers, nuclear anxiety was also highly charged by a transatlantic ideological alliance that saw Thatcher and Reagan marrying radical free-market policies with hard-line Cold War rhetoric. Yet, as the submissive pose of Thatcher in the poster illustrates, the relationship was not an equal one and it was haunted by anxieties about the decline of post-Imperial Britain and the rise of the United States as a superpower.

The shuttling back and forth across the Atlantic of nuclear discourse (generated not only by the closely aligned strategic policies and economic reforms of the Thatcher and Reagan governments, but also by vehement opposition to them) was hence an important feature of the cultural reception of nuclear issues in the 1980s. This paper assesses the role of this transatlantic nuclear culture, with particular attention to its treatment in literary texts from both Britain and the United States. The paper reads nuclear texts not only as sites in which specifically nuclear concerns (like the controversial decision to site American cruise and Pershing missiles in Britain; like debates over the nuclear winter theory) were played out, but also as places where a broader set of transatlantic concerns – about economy, society and culture – were contested

Robert JACOBS | Hiroshima City University, Japan

Mick BRODERICK | Murdoch University, Australia

The Global Hibakusha Project

Many communities around the world continue to suffer from the effects of radiation exposure, primarily from nuclear weapon testing, but also from the civilian use of nuclear power, and from the manufacture of materials used in both nuclear weapon and nuclear power production. While the epidemiological issues related to radiation exposures have been the subject of many studies, the social and cultural effects on families and communities has been neglected. The Global Hibakusha Project is engaged in a comprehensive study of the social and cultural fallout from atmospheric nuclear weapon testing on the many test site communities of the early Cold War. Additionally, the GHP is also working to create linkages between technology savvy youth in hibakusha communities through the utilization of Web 2.0 technologies. Whereas previous movements to link hibakusha communities were necessarily dependent on the work and relationship of community leaders, the internet age has opened up the possibility of broader, youth driven community formation. The establishment of an online community of hibakusha youth from around the world will lead to the creation of future community leaders, and sustainable relationships between hibakusha from disparate communities. This paper will detail the work to date and future plans of the Global Hibakusha Project.

Jonathan HOGG | University of Liverpool, United Kingdom

Nuclearity and cities

This paper will be a series of reflections on the concept of 'nuclearity'. Hogg introduced a definition of the term in a recent article in *The British Journal for the History of Science*. Can we use the concept to develop our understanding of how nuclear anxiety influenced everyday life, urban planning, and local politics in cities? Can transnational comparisons develop our understanding, or should we aim towards localised case studies? Linked to an emerging research project, the paper will be an opportunity to share ideas around the problem of historicising nuclear anxiety.

S077-D

Sat 27 July, 16:00–17:30 • Uni Place 1.218

Chair: Joseph MASCO | University of Chicago, United States

Ele CARPENTER | Goldsmith's, University of London, United Kingdom

The culture of nuclear dismantling, concerning the nature of the object, invisibility and time

This presentation will introduce Ele Carpenter's curatorial research project into the culture of dismantling British Nuclear Submarines in the 21st Century. The research aims to establish a context for commissioning artists to make new work alongside the process of dismantling nuclear submarines and the anticipated geological storage of nuclear waste.

The Submarine Dismantlement Project and its Advisory Group is hosting the first public consultation process led by the Ministry of Defence. This culture of openness about our collective responsibility for nuclear production and dismantlement creates a unique opportunity for artists to engage with the nuclear field. The complexity of dismantling nuclear submarines is a cultural as well as technological and political challenge that needs critique within a more conceptually nuanced understanding of materiality, ethics and aesthetics.

Drawing from interdisciplinary knowledge and approaches from art, science, literature, philosophy and sociology, the research aims to map the conceptual scope of the nuclear field. Pertinent areas of investigation for this presentation include: the political agency of the object, the nature of invisibility, and the complex challenge of nuclear semiotics.

The Object: The argument that tools and machines are benign objects without political or ethical intent will be challenged in relation to current thinking about the nature of objects within art theory and sociology. Whilst language has been thoroughly investigated throughout the humanities, the agency of the object needs to be investigated with equal rigour. This will offer a new ethical framework for rethinking the language of nuclear culture and decision-making.

Invisibility: Radioactivity is the ultimate invisible power outside our field of sensory perception. The problem of trying to understand or represent something we can't see engenders many myths and fears about radiation and submarines. Whilst artists rework modes of perception and representation, rendering the invisible visible, radiation creates an absence in an image of itself, bleached through the photographic image.

Time: Nuclear Semiotics is the discourse of language and meaning surrounding the ways in which we warn future humans not to interfere with underground nuclear storage sites. Storing nuclear waste for over 100,000 years shifts our sense of time and responsibility for the future. Belief systems such as religion, mythology and folklore are previously successful forms of passing information along the generations. But how does this new awareness of time affect our understanding of the present and what kind of archives do we need for the future?

Richard MAGUIRE | University of East Anglia, Norwich, United Kingdom

The psychology of nuclear decision-making: group polarisation and the Polaris Upgrade Programme, 1967-1979

This paper proposes to approach the issue of 'transnational nuclear perspectives' by linking the study of British nuclear history to behavioural psychology, and specifically the influential work of Nobel Laureate Daniel Kahneman and Amos Tversky, among others, on the topic of judgement and decision-making under uncertainty. It will use the story of the Polaris upgrade programme, whose *raison d'être* was the need to purport missile defences around the Moscow to explore the issues of how 'facts' and other knowledge-claims travel between knowledge-making enterprises and other groups: in this case British nuclear weapons scientists (and the civil servants closely involved with them), and those politicians and civil servants they were advising. In doing so it will argue that the claims for nuclear programmes that were presented at the time as deliberative and logical (and have continued to be so in the historiography) can only be understood through an examination of the heuristics and biases – subjective assessments made using adjustment, anchoring, representativeness and availability as well as group polarisation.

Daniel GRAUSAM | Durham University, United Kingdom

Radioactive visibility

Part of radiation's potential danger comes in no small way from its invisibility, and this paper consequently explores strategies in recent installation art, collage, photography and literature for making radioactive danger visible. Drawing on the artwork of Jim Sanborn, Taryn Simon, and Lisi Raskin, I argue that their aesthetic projects go beyond merely confronting the epistemological problem of visibility, however. Instead their complicated aesthetic strategies for revealing site-specific invisible danger have the paradoxical effect of decoupling that danger from particular spaces and times, thereby revealing a nuclear economy as a continuing and constitutive part of everyday life even in post-Cold-War America. That is to say that even as their solutions to the problem of making radiation visible enable us to see its danger, they also reveal to us the poverty of thinking of the Cold War's material nuclear legacy as restricted to a few key emblematic sites (Los Alamos, Hanford, Oak Ridge) and as something we have transcended. These points are extended in the second half of the paper where I turn to recent novels (Carter Scholz's *Radiance*, Marianne Wiggins's *Evidence of Things Unseen*, and Jonathan Lethem's *Amnesia Moon*) that make nuclear (in)visibility central to their plots while complicating dominant conceptions of where (and when) the Cold War nuclear project was located.

Commentary: Joseph MASCO | University of Chicago, United States

S078. Collecting and using oral histories of science and technology: international perspectives

Thu 25 July, 09:10–12:40 • Uni Place 2.219

Symposium organisers:

Ronald DOEL (non-participant) | Florida State University, United States

Sally HORROCKS | University of Leicester, United Kingdom

Symposium abstract

In recent years there has been a significant increase in the number of oral history projects dedicated to collecting the memories of scientists and technologists and a significant expansion in geographical coverage, taking it beyond the initial stronghold of the United States where much of the early activity was concentrated. At the same time the advent of the internet has raised the possibility of making these and existing collections more widely accessible. In addition, pressures on the academic community to engage more effectively with the public have highlighted the potential of oral history collections as resources around which this engagement can be built. The aim of this symposium is to bring together scholars from a range of nations, projects and institutional backgrounds to consider both the practical issues that they have faced when collecting, archiving, and disseminating oral history material and the methodological challenges and opportunities that oral history presents to historians of science and technology. This will enable participants to explore common issues as well as identifying those which affect individual national contexts. Key aims of the symposium are the sharing of knowledge on best-practice and to provide a supportive network of contact for those seeking to establish their own projects as well as enabling scholars to draw the attention of a broad international audience to their projects.

This symposium addresses the conference theme in a number of ways. It will consider oral history as a key tool which can enable historians of

recent science to shed light on the creation, dissemination and deployment of knowledge, capturing aspects of knowledge at work that are not always accessible in written records. It will also discuss ways in which knowledge of the history of science and technology is put to work in a range of settings, including digital media.

S078-A

Thu 25 July, 09:10–10:40 • Uni Place 2.219

Chair: Sally HORROCKS | University of Leicester, United Kingdom

Cláudia CASTELO | Instituto de Investigação Científica Tropical, Portugal

Collecting and using oral histories of science done in the Portuguese colonies

IICT, Tropical Scientific Research Institute, is the former Portuguese Board for Overseas Researches (1936-1973) that was responsible for science in and about the Portuguese Empire. IICT has several scientific collections gathered during scientific missions to the Portuguese colonies.

The IICT project «Scientific heritage: collections and memories» aims at creating an archive of interview for the study and disclosure of Portuguese «colonial science», from its protagonists' personal perspective. The project team includes an historian of Portuguese imperialism, Cláudia Castelo, the project's coordinator, who does also the background research, and prepares and conducts the interviews; Rogério Abreu, an Anthropologist responsible for videotaping and editing the interviews; and Marta Costa, an Anthropologist, that catalogues the interviews, does the abstracts and indexation. Edited excerpts of the audio and video records and the transcripts will be available online at ACTD – Tropical knowledge digital repository (<http://actd.iict.pt/>), created and developed by Yuri Binev. The complete interviews will be available on-site at IICT.

Between late 2009 and 2012 the project's team has done 30 in-depth interviews with scientists and technicians who have done fieldwork in the Portuguese colonies, in several areas of study – Agriculture Sciences, Botany, Geodesy, Geography, Geology, Political sciences, Social Anthropology, and Zoology.

My communication presents this oral history project, discuss the difficulties and challenges of interviewing scientific and technical experts that developed research in and about the Portuguese Empire and point out some historical themes which have emerged from the interviews, including those about which that the interviewer did not ask, revealing the unpredictability of the oral history

The 'life story' nature of the interviews allows that the interviewees to talk about several aspects of their life: family and social origins, career, leisure, networks, etc. Topics outside the central themes – «colonial science», scientific missions to the colonies, scientific collections – emerge during the interviews, such as the interviewees perceptions about *Estado Novo* dictatorship, colonial situation, colonial wars and decolonisation. The oral records that our project is creating will provide a resource for historians of science and imperialism, but also for other researchers with interests that have nothing to do with «colonial science».

Thomas LEAN | British Library, United Kingdom

'How on earth does your mind work to ask a question like that?' Reflections on interviewing engineers and applied scientists for An Oral History of British Science

In this paper I reflect on three years interviewing on the British Library's An Oral History Of British Science. I explore how we turned our strategic hopes for the project, as a cross section of past scientific activity in

Britain told through the voices of those involved, into a reality, by discussing practical fieldwork experiences of interviewing scientists and engineers. An oral history project of this nature creates sources for historians, but also individual histories, each with its own story to tell and impressions of the past that differ from the considered accounts of historians far removed from events. I discuss questioning and navigating the differences in mindset between historian and scientist, and how this conditions the interview and creates a dual authored document: the memories of the individual scientist or engineer shaped through conversation with a historian, creating a blend of science, history of science, and life story oral history. I consider some of the challenges of conducting oral life histories focused on the individual, with people who spent their lives caught up in teamwork environments and large, complex technical systems with life stories of their own. Finally I consider what such material, both individual interviews and collectively, adds to our understanding of the history of science in Britain and its practitioners.

Per LUNDIN | Uppsala University, Sweden

Documenting the use of computers in Swedish society between 1950 and 1980

This paper contextualizes, describes, and evaluates the project "From Computing Machines to IT," which was carried out during 2007–8 as a collaboration between the Swedish Computer Society, the Division of History of Science and Technology at the Royal Institute of Technology (KTH), and the National Museum of Science and Technology. The project aimed to create, collect, preserve, and disseminate sources on how computing shaped and transformed Swedish society between 1950 and 1980. For this purpose, it adopted a user-centered perspective on the history of computing.

In the project, more than 160 interviews were conducted, almost 50 witness seminars were arranged, and about 230 autobiographies were acquired with the help of traditional questionnaires as well as an Internet-based collection of memories (the Writers' Web). The created sources consist of more than eight thousand pages of text. All in all, nearly seven hundred people contributed with their stories. The contacts with these people generated, in turn, several donations of archival records, artifacts, movies, and photographs.

Earlier international documentation efforts in the history of computing are surveyed, and it is pointed out that these have mainly focused on documenting the role of pioneers in computing technology and largely ignored the users of computing technology. Thus, the research tools and methods that they have developed, used, and refined for documenting pioneering figures—in particular the oral history interview—cannot uncritically be adopted for documenting the activities of users. Lacking an obvious model to blueprint, the project "From Computing Machines to IT" chose to employ an ensemble of different methods for documenting the use of computers in Swedish society. Traditional oral history interviews and collections of autobiographies were used alongside new self-structuring and time-saving methods, such as witness seminars and the mentioned Writers' Web site.

Finally, it is stressed that the active interest of the communities of computer users was pivotal for realizing the project. In order to arouse their interest, two things were considered crucial: firstly, the importance of an active and continuous collaboration between historians and practitioners. This collaboration shaped the methods, the organization, and the theoretical approach of the project; and, secondly, the importance of creating events where practitioners are given the chance to gather for discussing and remembering their historical past and, at the same time, socialize. While witness seminars and the specially designed Writers' Web were seen as pure intellectual ventures by historians, they were actually received as social events by practitioners.

S078-B

Thu 25 July, 11:10–12:40 • Uni Place 2.219

Chair: Greg GOOD | American Institute of Physics, United States

Tamar GROVES | University of Salamanca, Spain
Santiago M LÓPEZ | University of Salamanca, Spain

Negotiating the original sin: professional narratives of women medical scientists in Spain

The faculties of medicine were one of the first academic institutions to accept women students in late 19th century Spain. However the establishment of the Franco Regime in the 1930s curbed the integration of women in the workplace in general and in academic professions in particular. The dictatorship's discourse and policies encouraged women to assume the traditional role of wife and mother. In the 1960s Spain transformed from a rural backward country into an urban industrialized society. This socioeconomic change facilitated the gradual incorporation of women into the public sphere. This brought in its wake a gradual augment in women's presence in the University. The number of women studying medicine increased significantly, but their weight in academic research was negligible. In this paper we analyze the professional narratives of the first women to become members of the faculties of medicine in the region of Castile and Leon. This mostly rural and conservative region was strongly associated with the Franco regime and with its national project of unification. It thus provides a suitable case study to explore the integration of women into medical scientific research in areas where traditional values of the regime prevailed. The story of the region's first women medical scientists exposes the social, professional and personal barriers they had to overcome. More importantly, analyzing their narratives discloses how they had to negotiate the original sin associated with their ability to establish a career as scientists in a male dominated environment. Our first interviews indicate that a marital connection to another member of the academic staff is a significant feature of these success stories. This adds another dimension to the original sin of these women related to their position in the scientific community. It naturally obliges them to negotiate its meaning and significance for their scientific careers.

Paul MERCHANT | British Library, United Kingdom

Oral histories of places and materials

This paper is concerned with what British Earth scientists say about their objects of study - whether glaciers, trees, parts of the atmosphere, areas of sea and ocean, or grains of sand - in extended life story interviews collected recently by *National Life Stories*, at the British Library. I argue that life story oral history gives Earth scientists a rare opportunity to reflect at length on scientific practice and that, in doing so, these scientists often acknowledge the role of particular places and materials in scientific work. It is in these unhurried, autobiographical stories, rather than in tightly written scientific papers, that Earth scientists link theories and observations to the individuality of field sites and samples. Particular expanses of ice, depths of water, masses of air, and collections of minerals seem to play along, or not, in these stories of science.

Sally HORROCKS | University of Leicester, United Kingdom

Developing an oral history web resource: Voices of Science at the British Library

How do you turn hundreds of hours of life story interviews with scientists and engineers into a web-resource that will be attractive to a wide range of users outside the history of science community but which also offers a window for researchers onto the extended archive? This was the challenge facing the Oral History of British Science team when we started work on the web resource intended to showcase the results of a major fieldwork project based at the British Library under the auspices of National Life Stories and which will, by the congress, have collected over 100 interviews with engineers, earth scientists, applied scientists, oceanographers and the technicians that supported them. This paper will describe how we went about curating and collecting content for the web resource, how our efforts linked with the other types of expertise

required to create it and what we learned about how users engage with material online. We will suggest how our experience might be drawn upon by others seeking to develop a resource of this kind and hope to be able to demonstrate the finished product, due to go live in early summer 2013.

S079. Materia medica and pharmacy: from the medicinal virtues to the active principles of plants

Tue 23 July, 09:10–12:40 • Uni Place 3.205

Symposium organisers:

Marcia H. M. FERRAZ | Pontifícia Universidade Católica de São Paulo, Brazil

Patricia ACEVES | Universidad Autónoma Metropolitana Xochimilco, Mexico

Symposium abstract

The simple drugs listed in works on materia medica and pharmacy were long considered until the 18th century as the basic materials composing the three kingdoms of nature. Also during this same long period, a continued discussion was held on the elementary principles that gave rise to such basic materials.

Extant sources seemingly indicate that the notion of material principles and the quest to establish the origin of materials walked together inasmuch as the latter gave the necessary weight to the former. As concerns laboratory work, both notions were operative also in the processes currently known as analysis and synthesis.

Along the 17th and a large part of the 18th century, chemical analysis sought to identify the elementary principles of the investigated materials, while a tendency developed to multiply the number of such principles or "virtues" (a common name then applied to the ultimate principles that allegedly characterised materials). In time, some of these principles and particularly the one obtained from the organised kingdoms became what today we call active principles.

A common idea among scholars maintains that the history of modern, essentially experimental pharmacology started at the beginning of the 19th century, when the first alkaloids were isolated. Indeed, in addition to the transformation it induced within the realm of pharmacology, the notion of "alkaloids" made a significant contribution to the development of organic chemistry and more particularly, to the studies on the active principles of drugs.

A closer look into the history of the isolation of alkaloids, however, shows that it belongs with a much wider context full of ups-and-downs, and where the isolation of active principles, as a fact, effected a radical transformation of the idea of simple drugs and consequently, also of the corresponding literature.

The present symposium aims at discussing the transition between the traditional notions about simple drugs and material principles, and the modern idea of active principles as reflected in the specialised literature, namely the works on materia medica, pharmacy, pharmacopoeia, pharmacology and therapeutics.

S079-A

Tue 23 July, 09:10–10:40 • Uni Place 3.205

Chair: Vera DOROFEEVA-LICHTMANN | CNRS-EHESS, France

Liliana SCHIFTER | Universidad Autónoma Metropolitana
Xochimilco, Mexico

Patricia ACEVES | Universidad Autónoma Metropolitana
Xochimilco, Mexico

Chemistry and pharmacy at the Instituto Médico Nacional: tradition and modernity in Mexico (1890-1915)

The *Instituto Médico Nacional* (National Medical Institute), established in Mexico City in 1888, was the most important research centre of local medicinal plants used by the general population for therapeutic purposes until its closure in 1915. During this period, the main line of investigation of Mexican pharmacy focused on the plant materia medica, as shown by the various editions of the Mexican pharmacopoeia.

The Institute was originally organised five sections: Natural History, Analytical Chemistry, Experimental Physiology, Clinical Therapeutics, and Medical Geography and Climatology. In 1903 the establishment of a sixth section, i.e., the Department of Industrial Chemistry was proposed, which was inaugurated on 1911. The Institute's investigators included doctors, pharmacists, and natural historians.

The investigated plants circulated across the various sections, where they were processed into active ingredients and drugs for public health and industrial use. The laboratories of the second and sixth sections quickly became the most important facilities devoted to chemical research at that time. Those laboratories were devoted to the isolation and characterisation of the chemical structure of the purified active ingredients of plants, among other chemical analyses. They further elaborated pharmaceutical preparations, which were then subjected to testing at the third and fourth sections. The staff of those sections, thus, comprised mostly pharmacists, who were also professors at the National School of Medicine, and members of the Mexican Pharmaceutical Society.

The results accomplished by that generation of professionals have no precedents in Mexican history. They published the most comprehensive texts on pharmacology and Mexican materia medica of that time. The pharmacists from the second and sixth sections founded the Mexican Chemical Society in 1910, and were the main promoters of the institutionalisation of chemistry at the Faculty of Chemistry and Pharmacy of the National University of Mexico at the beginning of the 20th century.

Vera Cecília MACHLINE | Pontifícia Universidade Católica de São Paulo, Brazil

Luso-Brazilian antiscorbutic herbs

Works by João Curvo Semedo (1635-1719) and Francisco Suárez de Rivera (c. 1680-1754) attest that the Iberian world participated in the eighteenth-century enterprise of seeking explanations and formulas for scurvy. For instance, in his *Manifestación de Cien Secretos del Doctor Juan Curvo Semmedo*, Suárez de Rivera contends that there are two kinds of scurvy: a "hot" brand, generated by an "acid, colliquative toxic", and a "cold" one, brought about by an "acid" ferment. Likewise, the Spanish physician recommends caution when using "hot, or acid, antiscorbutics, like cochlearia", as "they are always harmful to bodies of hot, sulfuric temperament".

In other words, Suárez de Rivera appears to share with British medical thinkers such as John Woodall (1570-1643), Edward Strother (1675-1737), and John Quincy (?-1722) the belief in the existence of two forms of scurvy, each demanding a distinct therapy. According to Elwyn Hughes, held to be "hot" and "alkaline", "sea scurvy" was treated with "cooling" foods and medicine, while "land scurvy", characterized as "cold" and "acid", required "hot" antiscorbutic herbs. Interestingly enough, citrus fruits, "the proven remedy for sea scurvy, did not figure prominently in the therapy advocated for 'land scurvy'". Treatment of the latter "almost invariably included at least one preparation made from [...] 'antiscorbutic' plants." These "usually included at least two of what

became an established triumvirate, namely, in modern terminology, *Cochlearia officinalis* (scurvy grass), *Veronica beccabunga* (brooklime), and *Nasturtium officinale* (water cress)."

As shall be detailed in this paper, seventeen-hundred Iberian physicians and, as well as Portugal-born licensed surgeons residing temporarily or definitively in the colony of Brazil, advocated a fourth antiscorbutic herb. Called "mastuerzo" by Suárez de Rivera, this plant seems to be *Lepidium sativum* – nowadays belonging to the Brassicaceae family, together with *Cochlearia officinalis* and *Nasturtium officinale*. The surgeon Luis Gomes Ferreira, who after returning to Portugal for good in 1731 wrote the medical handbook *Erario Mineral*, reports that such herb was named "mastruços" in Portuguese, and that this, or a similar cress-looking vegetable, was known elsewhere in Brazil as "herva de Santa Maria". Thus, Luso-Brazilian antiscorbutics may have included from the start today's *Chenopodium ambrosioides*, which, presently, is one of many other popularly known "mastruços" in Brazil.

Marcia H. M. FERRAZ | Pontifícia Universidade Católica de São Paulo, Brazil

Ana Maria ALFONSO-GOLDFARB | Pontifícia Universidade Católica de São Paulo, Brazil

The definition and isolation of "active principles" of plants in the early-nineteenth century

A.-L. Lavoisier's ideas on matter, and more particularly his operational definition of the chemical element, gave a satisfactory solution to all or most of the problems posed by the composition of mineral bodies. Thus, chemical analysis not only indicated the elements composing a mineral body, but also provided the key to the understanding of their properties.

In the case of organised bodies, however, chemical analysis could only show they were composed by a small number of elements. In *Traité élémentaire de chimie*, Lavoisier explains that as chemical analysis showed plants to be mostly composed of hydrogen, oxygen, and charcoal, the various properties exhibited by the bodies from the plant kingdom and used, e.g., as medicines, were determined by double and triple affinities.

Long known as "medicinal virtues", such properties manifested by means of so-called "medicinal principles" – or "active principles" – whose presence in a given material lent it its characteristic identity, and distinguished it from all others. One of the major problems as how to isolate such principles, since distillation – then a common procedure to decompose the organised bodies – destroyed them, or gave rise to substances non-existing in the source material.

Within that context, in the section devoted to "plant chemistry" of *Système des connaissances chimiques* (1801), A.-F. Fourcroy suggests "means to decompose the products of plants, and discover the order of their composition". He explains that four different kinds of analysis - immediate or proximate, mediate or remote, simple or true, and complicated or false analysis - originate also different 'products'. Only "true analysis" allows isolating the 'compounds' related with the medicinal action of plants, and thus, a thorough knowledge of that process would not only make the preparation of medicines easier, but would also allow clustering together the plants exhibiting one same effect. Still more important, "true analysis" could contribute to the understanding of the action of medicines in the human body (or "animal economy", according to the expression used at that time).

In the present study, we address the debate among Fourcroy and other contemporary scholars on the possibilities to isolate and recognise the "medicinal" or "active principles" at a time when elementary composition was considered as the key to the understanding of the nature of substances. (Funded by FAPESP – Proc. 2011/14040-9 and CNPq – Proc. 309691/2011-7)

S079-B

Tue 23 July, 11:10–12:40 • Uni Place 3.205

Chair: Vera Cecília MACHLINE | Pontifícia Universidade Católica de São Paulo, Brazil

Silvia WAISSE | Pontifícia Universidade Católica de São Paulo, Brazil

Conrado M. TARCITANO FILHO | Pontifícia Universidade Católica de São Paulo, Brazil

Opium before morphine: the elusive quest for the active principle of drugs

The idea that the history of modern, essentially experimental, pharmacology began in the early years of the 19th century is widely shared by scholars. The emblematic milestone of that view is the isolation of morphine by Friedrich Sertürner in 1805. Morphine was, thus, the first plant alkali (alkaloid), and also the first organic substance identified. In addition to allegedly exerting large influence on the understanding of the composition and behaviour of matter, as well as inducing a major transformation within the field of pharmacology, the notion of "alkaloid" as active principle of plant matter contributed to both, the development of organic chemistry, and to the disciplinary autonomy of the plant sciences. Therefore, the notion of "alkaloid" is at the very centre of the modern process of specialisation of science, which was based on the dissolution of the traditional links among the three kingdoms of nature that hereafter were reconfigured on the grounds of other models as, e.g., the cycle of matter. Nevertheless, a closer look into 18th century pharmacology shows that contemporary scholars were utterly persuaded that there were principles of activity in matter, and that they could be isolated in the laboratory. In the present study, we discuss the quest for the active principle of opium by two highly influential 18th century scholars. Charles Alston (1683-1760), the famous Edinburgh professor of materia medica, published in *Medical Essays and Observations*, in 1752, a monograph entitled *Dissertation on Opium*, which was widely read and deeply informed the contemporary ideas on the operation of opium. Also from Edinburgh, John Murray's (d. 1820) *Elements of Materia Medica and Pharmacy* (1802) exhibits one of the earliest applications of the novel conception on the "chemical elements" to the knowledge on the composition and action of drugs. By addressing the ideas of Alston and Murray we are granted a glimpse to the more widely spread ideas on the activity of matter on the very eve of Sertürner's discovery. [Support: FAPESP No.2011/14040-9]

Vera DOROFEEVA-LICHTMANN | CNRS-EHESS, France

Spatial arrangement of healing plants in the *Shanhaijing* (itineraries of mountains and seas, composed first century BC)

The *Shanhaijing* (Itineraries of Mountains and Seas, compiled about the 1st century BC) occupies a special place among terrestrial descriptions surviving from ancient China. It is distinguished by the multiplicity of details provided for the described landmarks, plants in particular, and, at the same time, a remarkably systematized presentation of this voluminous data.

The core part of the text, the *Wu Zang Shan Jing* (Five Treasuries: The Itineraries of Mountains), provides an account of 447 mountains arranged into twenty-six itineraries. The itineraries, in their turn, are ordered with respect to the four cardinal directions and the centre. This system of itineraries covers the central part of the inhabited world focussed on the basins of the Yellow and the Yangzi Rivers, and delimited at each cardinal direction by a sea.

The spatial system of twenty-six itineraries has two main properties:

- 1) Each itinerary submits to a special group of local spirits.
- 2) The system of itineraries ascribes to each mountain a unique and precise "position".

Therefore, all the attributes of mountains described in the text have to be regarded from the point of view of their placement in the sacred landscape.

The mountains are featured in a uniformly formulaic way according to recurrent characteristics. These characteristics are the plants, animals and minerals found on a mountain, and the river(s) emanating from it. As a rule, these beings and things have extraordinary properties.

Plants are the most important attribute of each mountain's description, and many have healing effects. In the proposed paper I shall explore the distribution of plants among to the twenty-six cardinal-oriented itineraries, paying attention to the spatial arrangement of their healing qualities and its relation to the spatial arrangement of local spirits.

I shall demonstrate that the systematized arrangement of data in the *Shanhaijing* that inspired many Chinese and some Western scholars to refer to this text as to a compendium on botany, zoology, medicine, etc. is markedly different from modern science. In particular, the listed plants are part of a system that simultaneously embraces cosmological, religious, political, topographical and other dimensions which cannot be disaggregated, as they are part of a single, complexly interrelated whole. This system, however, provides a framework for the detailed and uniform description of plants with healing properties.

Mariana ORTIZ | Universidad Autónoma del Estado de México, Mexico

Angélica MORALES SARABIA | Universidad Nacional Autónoma Metropolitana, Mexico

Psycho-active drugs research within Mexico's Instituto Medico Nacional, 1888-1915

The present paper analyzes the work carried out in the Instituto Médico Nacional (IMN), between 1888 and 1915, relating to psychoactive molecules. So far the historiography of the IMN studies on these substances has not been addressed in depth, both in what regards to publications and to the place nervous diseases occupied in the Institute's research agenda.

The objectives of the present work are to identify which psycho-active drugs were studied by the IMN, in what natural species were found (like zapote blanco, madroño borracho or tepozán, for example), as well to define the diseases for which they were targeted (such as insomnia or nervous breakdown) and their treatment.

We also review the legislation on the control of narcotic drugs and psychotropic substances as well as the sanitary laws and the rules contained in the national pharmacopoeia. It was in the first quarter of the 20th century when authorities began to control the use and abuse of the so-called heroic drugs and the popular concept changed from "useful" to "race-degenerating, vice forming" drugs.

Some findings on hypnotic substances yielded by the IMN were published in the *Datos para la Materia Medica Mexicana* (1898, 1900) and later, in the *Farmacología Nacional* (1913). Also around this period, negotiations between the IMN and the pharmaceutical House Parke Davis & Son of New York began in order to exploit commercially the active ingredient *casimiroso* found in zapote blanco. This substance was used successfully in hospitals and in folk medicine due to its sleep restoring properties and lack of side effects. The plant madroño borracho provided a similar hypnotic action as the casimiroso. In the case of the tepozán, its diuretic, hypnotic and analgesic properties were acknowledged, yet at the time the IMN disappeared in 1915, investigations were still in experimental stage.

Célia CABRAL | University of Coimbra, Portugal

Pharmacy, cinchona and quinine in Portugal from the eighteenth to the twentieth century

Cinchona/quinine occupied a very important role in medical therapeutics and pharmacopoeia in Portugal and several other European countries. Therefore, it became the object of thorough botanical and chemical studies, as well as of trading and industrial interest. The present study approaches the representation of cinchona and quinine in the Portuguese specialised literature, namely the works on materia medica,

pharmacy, pharmacopoeia, pharmacology and therapeutics. Consistently, it begins with a brief outline of the historical uses of cinchona in Portugal.

Next, we approach the controversy among scholars from Coimbra and Lisbon, between 1810 and 1812, following the isolation of cinchonine by Bernardino António Gomes. To remind, the product isolated by Gomes ("cinchonine") turned to represent the first alkaloid extracted from cinchona, and as a fact, the original discovery of quinine.

Cinchona was introduced in the Portuguese pharmacopoeia quite early. Although neither the first Portuguese pharmacopoeia ever published, i.e., *Pharmacopea Lusitana* (1704), by Caetano de Santo António (d. [ca. 1730]), nor the first official pharmacopoeia, i.e., *Pharmacopea Geral* (1794), by Francisco Tavares (1750-1812) included monographs on cinchona, they both described medicines which included it as component. In turn, analysis of contemporary medical prescriptions shows that the therapeutic use made of cinchona agreed with the stipulations of the Portuguese pharmacopoeia, as well as the influence of the *Edinburgh Pharmacopoeia*. Starting in the 19th century, the official Portuguese pharmacopoeia included several medications including quinine, as e.g., *Código Pharmaceutico Lusitano* (1835), *Pharmacopoeia Portuguesa* (1876), and *Farmacopeia Portuguesa* (1935).

The present study is completed by a discussion of 19th and 20th centuries studies on cinchona, as e.g., the ones by Tavares, Júlio Augusto Henriques (1838-1928), Joaquim dos Santos e Silva (1842-1906), José Cardoso do Vale (1911-2010) and Aloísio Fernandes Costa (1906-1980).

This presentation is based on work co-authored by João Rui Pita and Ana Leonor Pereira.

S081. Between physics and technology: the embodiment of knowledge in the inter-war period

Wed 24 July, 14:10–17:40 ▪ Roscoe 2.5

Symposium organisers:

Shaul KATZIR | Tel Aviv University, Israel

Falk MÜLLER | Goethe University Frankfurt, Germany

Symposium abstract

New findings, methods and inventions originated and developed in science, technology and their intersection shaped the research on nature, human products and practical methods during the inter-war period. This session explores a few ways by which new knowledge or knowledge perceived in a fresh way became a subject for research of physicists and engineers alike and shaped their working patterns and agenda. The focus will be on activities - new structures, methodologies and devices - that developed between the two disciplinary and professional realms of physics and engineering. The case studies will investigate the ways by which different kinds of knowledge were combined, transformed and put to work in various sub-disciplines and in their intersections.

Although a few historians have examined the influence of practical aims on scientific studies in the period, the issue still calls for a historical systematic treatment. On the one hand, this session attempts a modest step in that direction by assembling a few perspectives on the various ways by which technology and its goal oriented questions and approaches influenced developments in physics. On the other hand, new physical knowledge was embodied in technical devices, technological systems or new methodological approaches, which again retroacted on

the development, the shape and self-understanding of academic physics. The examples are taken from research done in academic as well as in industrial and military settings, by physicists as well as by engineers, although in their work they were not always distinguishable.

S081-A

Wed 24 July, 14:10–15:40 ▪ Roscoe 2.5

Chair: Roland WITTJE | University of Regensburg, Germany

Chen-Pang YEANG | University of Toronto, Canada

From radio technology to geophysics and back: the development of the magneto-ionic theory

This paper examines the development of the magneto-ionic theory for radio-wave propagation in the context of wireless engineering and atmospheric science during the interwar period. Among physicists and engineers, why radio waves can propagate over long distances was a curious phenomenon arising from the new radio technology. In the 1910s, William Henry Eccles at the University of London and Joseph Larmor at Cambridge University suggested that long-range radio waves bounce between the earth and an ionic layer in the upper atmosphere and the apparent wave reflection from the upper layer is actually an effect of ionic refraction. Throughout the 1920s, the explanatory power of this theory expanded significantly: Albert Hoyt Taylor and E.O. Hulburt at the U.S. Naval Research Laboratory used it to deduce the notable "skip effect" in short-wave communication. In addition, Edward Appleton and a few other researchers sponsored by the British Radio Research Board proposed that double ionic refraction due to geomagnetism could account for certain data on the polarization and range of propagating waves.

Dubbed as the magneto-ionic theory, this mathematical model nonetheless played a broader role than an explanatory device in the 1920s-30s, thanks to the introduction of a new experimental technique. In 1924-26, Appleton and Miles Barnett at Cavendish Laboratory and Gregory Breit and Merle Tuve at Carnegie Institution of Washington independently produced "direct" evidence for the upper ionic layer (the ionosphere) as they sent specially modulated radio signals upward and detected their return from the sky. This "radio sounding" scheme soon became the most important method to probe the characteristics of the ionosphere. With the efforts of Appleton and a few other British and American researchers, moreover, the magneto-ionic theory was integrated into the operation of the radio ionospheric sounder and the interpretation of its data and thus served as a "paper tool" for the active remote sensing of atmospheric science.

In the 1930s, Appleton's group in the U.K. and the U.S. National Bureau of Standards further extended the use of the magneto-ionic theory to short-wave radio engineering, as they came up with means of predicting optimum operating frequencies from the theory's interpretation of ionospheric sounding data. The scientific work inspired by technological issues was reapplied to the technology. Like other papers in this session, the changing roles of the magneto-ionic theory thus witness the close interaction between physics and technology in the interwar years.

Shaul KATZIR | Tel Aviv University, Israel

Study following application: the shaping of interwar piezoelectric research

Before WWI, piezoelectricity had not been used outside the laboratory, and had been studied by only few physicists. The war changed that with Paul Langevin's invention of piezoelectric ultrasonic detection technology, later known as sonar (which would form the core of medical ultrasonic scanning methods). In the war's aftermath, another physicist, Walter Cady, discovered the sharp and steady electric resonance of piezoelectric crystals, and consequently invented the method of crystal frequency control. Already in the early 1920s, engineers and physicists have realised the importance of this method for radio, telephony and

other application of electronics, leading to the invention of the quartz clock in 1927.

This talk will discuss the transformation of the scientific research of the phenomenon following its application, in both content and volume of research. Piezoelectricity attracted unprecedented attention from scientists in universities, and national and industrial research laboratories, becoming an independent sub-specialty in the interbellum. The vast majority of its researchers, like Cady, or the known theoretician Max von Laue, had not studied the field before the war. Most of the research was related to and stimulated by practical devices. In particular, the essential technological role of piezoelectric vibrations moved this hitherto unexamined oscillating crystals to the centre of research on the phenomena. Yet scientists often sought a deeper and more extended knowledge about this and other phenomena, beyond the needs of technology. Technological aims, thus, shaped the research in the field but did not limit it to questions of expected applicability. Still it seems that the technological application of piezoelectricity had a stronger influence on its knowledge and even on its *understanding* than developments in the general theories of physics such as the advent of quantum mechanics.

Jaume NAVARRO | University of the Basque Country, Spain

From electron diffraction to electron cameras.

George Paget Thomson at Imperial College in the early 1930s

In 1927, George Paget Thomson, professor of Natural Philosophy at the University of Aberdeen, obtained the first photographs of the diffraction of electrons, thus visually demonstrating for the first time de Broglie's principle on the wave-particle duality. His findings were a by-product of a long research program that he had started after graduation in Cambridge, in 1913, following after his father's steps. As a matter of fact that project was not interested in the behaviour of electrons but on positive rays and their uses for chemical analysis. The discovery of electron diffraction by two different techniques and two independent research teams (G.P. Thomson in Aberdeen and C. Davisson and L. Germer at the Bell laboratory) is a very nice example of the at times apparent disconnection between so-called pure and applied science. Neither team was, in the traditional sense of the word, carrying on theoretically-oriented research. Even in the case of G.P. Thomson, who was trained in both the Mathematical and Natural Sciences triposes in Cambridge, he hardly tried to be a theoretical (or mathematical) physicist, not even when his involvement in the de Broglie principle turned him into a spokesman and populariser of one of the most esoteric principles of the new quantum mechanics. In this paper I explore the career of G.P. Thomson after his experimental proof of electron diffraction, when he moved to Imperial College. There, he formed a team to develop what was known as electron diffraction cameras as a way to analyse microscopic and crystalline structures. Particular attention will be paid to the continuity between his pre-1926 positive-ray techniques and his post-1929 electron diffraction cameras, as well as to the mathematical technologies used in both programs. The latter will certainly help us better understand the extent to which Thomson's cameras should be seen only in the light of so-called applied science, especially at a time when theoretical physics was almost exclusively synonymous with foundational quantum and relativistic physics.

S081-B

Wed 24 July, 16:10–17:40 • Roscoe 2.5

Chair: Roland WITTJE | University of Regensburg, Germany

Edward JURKOWITZ | University of Notre Dame, United States

From cannon shell trajectories to atoms: Douglas Hartree and Ralph Fowler's World War I ballistics and the calculation of atomic properties

This paper studies the relationships between Douglas Hartree and Ralph Fowler's work during World War I computing ballistics tables for the British military and their later investigations into atomic physics.

Considering first their studies within the old quantum theory, and second their wave mechanical studies into the properties of atoms, the paper argues that these physicists took computational techniques developed and honed in the calculation of ballistic trajectories over into their later physics, and suggests that their approaches to atomic problems, as well as their outlooks on physics more generally, reveal subtle but important traces of their early computational efforts. More generally, the paper examines a pathway towards an early form of computational physics, one in which the requirements and limitations of computing helped guide physicists' strategies in atomic theory.

Falk MÜLLER | Goethe University Frankfurt, Germany

Until technology takes over: the development of Braun tubes and oscillographs at AEG in the 1930s and early 1940s

After its foundation in 1928, one of the central projects at the Research Laboratory (FI) of the German electrical company AEG was the development of Braun tubes and oscillographs. The example of the oscillograph can be used to show how a laboratory device was transformed into a technical system, how this system was conceived by different groups of actors (physicists, electrical engineers, management), and how it changed its form and function under changing requirements.

I am particularly interested in the role played by physicists and their expertise in this development. At the FI, the physicist Ernst Brüche and his colleagues tried to establish geometrical electron optics as a new branch of physics. They perceived the manipulation of 'free electrons' in Braun tubes as an interesting field to test their ideas, theories and methodologies. In my talk, I will discuss how these physicists negotiated with members of other groups what kind of physics, what tools, theories and experiences they could offer as suitable contributions to the development of oscillographs and other electronic devices. Did they manage to follow and establish their own agenda? How did they adapt their expertise, their ideas and methodologies to the needs and conventions of an industrial environment (e.g. communication with engineers and technicians, adaption to the conditions of mass production and the demands of patent law)?

Karl HALL | Central European University, Hungary

'Out of the labyrinth of recipe commerce': applied physics and insulation failure in the 1920s

The manufacture of insulating materials employed more than 60,000 people in Germany alone in the 1920s, when certain applied physicists hoped to develop a science of high-voltage insulators, briefly signaling the "dawn of industrio-physics." Their hopes turned out to be premature. No immediate predecessor to materials science emerged in this "declared borderland" where physics, chemistry, and electrical engineering overlapped, and these failures subsequently vanished from narratives of modern physics, though some of the protagonists were well versed in atomic theory. But this was more than a matter of brute empirical intractability in the early days of the quantum theory of solids. This episode, properly situated in the industrial research laboratory, can tell us much about the shifting meaning of "applied science" between the wars—and what patent lawyers have to teach us historians about the "artisan, handwork character of science."

S082. Ideological blueprints: rational choice, equilibrium and planned development in economics

Thu 25 July, 09:10–12:40 ▪ Roscoe 1.008

Symposium organisers:

Harro MAAS | Utrecht University, Netherlands

Tobias VOGELGSANG | London School of Economics, United Kingdom

Symposium abstract

Economics never was a neutral science. It always wavered between the ideological and the factual, and was in many cases both. This symposium will look at how economists developed blueprints to shape and explain the economic behavior of individuals and nations from the end of the nineteenth century into the decolonization period after the Second World War. The first session focuses on individual behavior, the second on national economies.

At the turn of the nineteenth century, the marginalist revolution in economics opened up a search for an explanation of economic behavior at the intersection of economics and psychology that was embedded in contemporary discussions on social and economic improvement. The nexus between psychophysics and industrial psychology infused debates in Germany on naturalistic interpretations of human behavior that culminated in the standard definition of the subject matter of economics as choice under scarcity. After the Second World War this definition was axiomatically reframed in terms of rational choice theory. The status of the axioms of rational choice, and the closely related notion of equilibrium, wavered between the normative and the descriptive. Discussions between the French mathematician and economist Maurice Allais and the American statistician Jimmie Savage, the work of Cowles Commission director Jacob Marschak, and floundering existence proofs of economic equilibrium in the 1950s and '60s urged economists to reconsider the behavioral foundations of their discipline – a reconsideration that brings them back to psychology.

Trust in shaping economic life was perhaps greatest where economists for at least a period after the Second World War felt most secure: the new field of development economics and macro-economic planning. Development economics' doctrine is that increases in welfare can be planned and accelerated through properly designed and implemented policies. This seemingly straightforward idea shall be deepened and disrupted through four case studies, from development economics' natural habitat, its historical precursor, and the foundations of welfare in agriculture and the monetary system. Redrawing the boundaries of Poland at the Versailles Peace Treaty conference was not only a deliberate attempt at state formation, but also of large scale infrastructural economic planning. In the process of state formation in Ghana over the period from 1922-1966, tools of descriptive statistics and accounting turned into ideological tools of indoctrination for changing the values and beliefs of the Ghanaian citizens. The rediscovery of Alexandr Chajanov's resistance to Soviet collectivization forced development economists to reconsider their emphasis on grand-scale agricultural reform projects as the self-evident road to progress. The last contribution examines the incapacity of the 'developed world' in setting policies that avoid financial crises and their ensuing large-scale annihilation of welfare.

S082-A. Equilibrium and rational choice

Thu 25 July, 09:10–10:40 ▪ Roscoe 1.008

Chair: Tobias VOGELGSANG | London School of Economics, United Kingdom

Harro MAAS | Utrecht University, Netherlands

Disciplining boundaries: Max Weber and Lionel Robbins on the definition of economics

This paper investigates Lionel Robbins's use of Max Weber's criticism of psychophysics in managing the boundaries between economics, history, and psychology in his Essay. Max Weber's criticism of psychophysics hinged on the notion of means-ends rationality. The logical structure of means-ends rationality made experimental and statistical methods of investigation redundant, turning its study into an analytical, rather than empirical and, for Weber, historical exercise. Robbins wholeheartedly accepted Weber's criticism of psychophysics, but rejected Weber's historicizing of the importance of means-ends rationality. Thus, Robbins turned the subject matter of economics into the a-historic study of constrained optimizing behavior. We see the irony of this position in contemporary neuro-economists' acceptance of Robbins's definition of economics to study the relation of brain-processes to behavior, while Robbins aimed to steer away from an investigation of man's physiology in the service of economics.

Floris HEUKELOM | Radboud University Nijmegen, Netherlands

Maurice Allais, Jimmie Savage and the Allais paradox

The Allais paradox, first presented over lunch by Maurice Allais to Jimmie Savage during a symposium in Paris in 1952, is among the best known decision problems in contemporary behavioral and social science. The present article documents the history of the Allais paradox, and shows that underneath the many discussions of the various protagonists, lay different, irreconcilable epistemological positions. This paper will explore these different positions and show their consequences for Kahneman and Tversky's seminal 1979 *Econometrica* article and the subsequent development of behavioral economics.

Till DÜPPE | Université du Québec à Montréal, Canada

Finding equilibrium: historiography and the reward system in science

In the wake of World War II, economics has undergone a transformation from a literary oriented discipline towards a scientific one. One central vehicle of this changing culture has been the use of mathematical proof techniques specifically in general equilibrium theory. This impersonal mode of expression provided a new meta-theoretical framework to the discipline but, as we show in this contribution, simultaneously affected the reward system of the discipline. We thus historicize the post-1945 transformation of economics by describing the effects it had on the role of scientific credit - issues that range from (co)authorship, refereeing process, supervision of students, down to scientific prizes such as the Nobel Prize. One self-reflective element of this discussion is to consider the historical accounts of the scientists as inherent to the negotiation of credit, and, concomitantly, the writing of the history of science as one layer of the changing reward system in a regime of impersonal knowledge. The exemplary case we consider is the existence proof in general equilibrium theory presented by Lionel McKenzie, and in a joint paper by Kenneth Arrow, and Gerard Debreu. The latter two have each received a Nobel Prize in 1972, and 1983 respectively, while the former remained less known to the broader community of economists.

Catherine HERFELD | Ludwig-Maximilians-Universität, Munich, Germany

Has there been a normative turn in postwar economics?

Since the second half of the 20th century, rational choice theory (RCT) has gained extraordinary prominence in economics and records a history of powerful applications across the social sciences. Disunity, however, exists among defenders and opponents alike with respect to its nature, status and role in actual economic practice. This disunity has given rise to fundamental disagreements and confusions about the theory's epistemic potentials and limitations. Drawing primarily on the writings of Jakob Marschak, I show that RCT underwent a fundamental transition after the 1950s that became reflected in its interpretation, application

and status within economics. Rather than providing empirically testable hypotheses about human decision-making that would enhance our understanding of actual behavior in the economy, the predefined elements that were taken as constitutive of rational action had been inspired by simple rules of logic that were meant to represent the basic demands of rationality. As such, the rational choice-framework specified a rule of conduct and thereby shaped rather than explained behavior. This transition has given RCT, and economics more generally, a 'normative turn', which suggests telling the history of RCT as an account of how rational behavior has, over time, become reinterpreted as rule-following behavior.

S082-B. Beyond, before and beneath planned welfare

Thu 25 July, 11:10–12:40 • Roscoe 1.008

Chair: Harro MAAS | Utrecht University, Netherlands

Tobias VOGELGSANG | London School of Economics, United Kingdom

Developing economies without development economics: the media of the Paris Peace Conference

At the Paris Peace Conference in 1919, after World War I, there was no development economics. Yet, many of the problems that the conference tried to solve were problems of development. Most prominently, Poland was resurrected as a nation state and should be given 'a prospect of continued life'. There could not be a Polish state without a territory, which meant that the national boundaries of the surrounding states had to be redrawn. To this end, the conference analysed transport infrastructure, deposition of natural resources, geographical features, production facilities and capacities, ethnic composition, history and many other features of the areas in question.

An analysis of the media, in particular the maps, that the conference used to debate and develop Europe's new boundaries will give insight into the conference's economic reasoning.

Gerardo SERRA | London School of Economics, United Kingdom

From scattered data to ideological education: economics, statistics and state-building in the Gold Coast/Ghana, 1928-1966

The paper, based on archival evidence collected in British and Ghanaian archives, analyses the contribution of economists and statisticians to the task of state-building in Ghana from the late 1920s until 1966. It argues that while in the 1920s and 1930s anthropology was the most relevant among the social sciences to serve the needs of the colonial administration, since the Second World War economists and statisticians became crucial in the task of state formation. The contribution of economics and statistics to state-building was threefold. Firstly, the need for increased and better statistical information to facilitate the task of economic planning led to an expansion of state capacity through the extraction of relevant information. Secondly, the employment of new techniques of macroeconomic accounting based on internationally accepted standards allowed the state to represent the national economy as an object of policy intervention, and legitimise itself. Thirdly, during the last years of Kwame Nkrumah's rule economic science (in the form of Marxist-Leninist political economy) was employed as a tool of ideological indoctrination. What was a descriptive science became in less than 25 years a tool for deliberately changing the values and beliefs of Ghanaian citizens.

Federico D'ONOFRIO | Utrecht University, Netherlands

Family farms and development economics in the 1970s and beyond

The rediscovery of Aleksandr Chajanov's *The economy of the peasant farm* in the 1960s paved the way for a reconsideration of agricultural policies in developing countries. Anthropologists were very quick in absorbing the main contents of Chajanov's analysis of the farm. They were interested in the decision mechanisms of peasant families, in order to understand their reactions to policies of development. Eventually, family farms came to be seen as an alternative to monoculture and large scale farming. In my contribution I intend to follow the spreading of the family farm model in recent development economics. I will introduce the reader to Chajanov's view on family farm, sketch how the rediscovery of his work took place in the 1960s, and then move to its long lasting influence on different authors.

John GENT | London School of Economics, United Kingdom

Too much or not enough? Money supply, welfare and financial crises

Irving Fisher developed his equation of exchange $MV = PT$ in 1909, after Stanley Jevons, the 19th century's great and innovative measurer of economics, had failed to estimate it. Today, thanks to national accounting and computers, we have great knowledge of these variables. Welfare economists debate the relationship between PT and society's aggregate wellbeing while monetary economists and central bankers refine MV mutations. Yet, the 'developed world' is still incapable of setting policies that avoid financial crises and their ensuing large-scale annihilation of welfare. Hence, the debate over the adequate endogenous supply of 'money' for Minsky's 'non-speculative' transactional purposes versus the appropriate exogenous constraint on that supply to ensure long-term stability is in dire need of a supplement. This requires an understanding of the processes that create debt-money in non-regulated markets.

S084. Social science, ideology, and public policy in the United States, 1961 to 2011

Mon 22 July, 11:00–17:30 • Roscoe 2.4

Symposium organisers:

Mark SOLOVEY | University of Toronto, Canada

Inderjeet PARMAR (non-participant) | City University London, United Kingdom

Symposium abstract

The great bulk of historical scholarship of American social science has focused on three earlier eras: the origins of professional social science in the late 19th and early 20th centuries; the interwar era and especially the 1930s, when large numbers of social scientists participated in the intellectual and political life of the New Deal; and WWII through the first couple Cold War decades, a period of enormous expansion in academic social science and significant social science influence on domestic and foreign public policy, especially during the Kennedy and Johnson administrations. In the last decade or so a number of important historical studies have focused on the 1960s and subsequent decades. Yet this latter era, which the present symposium concentrates on, has received much less attention than the earlier ones. Building on the insights of recent historical scholarship, this symposium also seeks to illuminate the "work" done by social scientists in the wider society regarding prominent issues including poverty, mental health, research ethics, educational reform, sexuality, race relations, crime, economic growth, and third world development.

Specifically, this symposium examines how American social science, psychology, and economics became involved in ideological struggles and associated public policy controversies from 1961 to 2001. Papers

presented by an international group of twelve scholars from Canada, the U.S., France, and England explore wider trends and issues in conjunction with specific case studies.

S084-A

Mon 22 July, 11:00–12:30 ▪ Roscoe 2.4

Chair: Tiago MATA | University of Cambridge, United Kingdom

Andrew JEWETT | Harvard University, United States

Neo-conservatism and the limits of social science

This paper will explore how political critiques of the welfare state in 1960s America intersected with epistemological challenges to claims of value-neutrality in the social sciences. The leading ideological defenses of the post-World War II “New Deal order” leaned heavily on the assumption that a robust, reliable social-scientific enterprise could arm an activist state with the knowledge it needed to intervene effectively in economic and social practices. From the late 1930s forward, the paper will argue, critics of New Deal liberalism routinely attacked this linchpin assumption about the character of social knowledge, even as they also made openly normative arguments against the welfare state and its policies. In other words, the strong epistemological claims underlying postwar American liberalism led its challengers to see epistemological criticism as a particularly effective form of political dissent. At the same time, this aspect of New Deal liberalism also inclined those who began by criticizing value-neutrality in the social sciences on epistemological (or religious) grounds to become suspicious of the policy orientations associated with the welfare state of that era. The convergence of politics and epistemology within the New Deal order led to a similar convergence of politics and epistemology among its opponents.

The paper will trace these dynamics among the early American neoconservatives who broke with conventional liberal views on race and poverty in the 1960s. Rejecting environmentalist understandings of human behavior, these figures attributed persistent social inequalities to disadvantageous personal traits imbued in individuals by an entrenched “culture of poverty.” In launching their political challenge, the paper will show, the early neoconservatives challenged not only the capacity of the state to eliminate poverty but also the capacity of social science to understand it. They rejected the possibility of value-neutral social knowledge in much the same terms that Catholic leaders and neo-orthodox Protestants had done since the 1930s, conservatives and some humanistic progressives had done since the 1950s, and radicals were beginning to do in the mid-1960s. In these political critiques lay some of the deepest roots of today’s scholarly interest in the social conditions and cultural matrices of knowledge-making, at least as that interest has found expression in American universities.

Alexandra RUTHERFORD | York University, Canada

Feminist social science and social policy in late twentieth-century America

The links among gender, social science, and social reform in the Progressive Era have been well documented by historians (e.g., Furner, 1975; Leach, 1980; Silverberg, 1998). These scholars have considered the ways in which the formalization and institutionalization of the social sciences in this period gradually forced an artificial divide between the reform-oriented work of (often) female social scientists and the university-based “scientific” work of (often) male social scientists. By the late 1960s, concurrent with the rise of second wave feminism in the United States, explicitly feminist social sciences such as feminist psychology and feminist sociology emerged as recognized academic subfields even as they struggled to defend their scientific status in an era in which the boundaries between social science and popular movements for social justice were even more rigidly drawn. In this paper I examine several ways in which feminist social scientists in this period attempted to use their research to change social conditions and national policies

affecting women, and the challenges they faced as women and as scientists in doing so.

I draw specifically on the rise of social science research on violence against women in the 1970s to explore these challenges. As several historians have documented, after a brief period of attention drawn to family violence and wife-beating by reformers in the mid-late 1800s (sometimes allied with the Social Purity and Temperance Movements; see Breines & Gordon, 1983; Davis, 1991; Pleck, 1987), the framing of “violence against women” as a social problem would not emerge again until the 1970s. When it did, feminist social scientists turned their attention, and the tools of science, to the issue. As activist scientists working from inside the academy, what did they see as the relationship between their work and the work of social reform? What were the relationships (if any) between grassroots activism and academia? What role did professional/scientific associations, such as the American Psychological Association and the American Sociological Association, play in brokering social science research to policy makers? In this paper, I explore these questions in the period up to the passage of the Violence Against Women Act of 1994 to elucidate the ongoing complexity of navigating the science-policy relationship.

Angus BURGIN | Johns Hopkins University, United States

Methods of freedom: conflict and consensus in the free-market right

In recent years scholars have increasingly referred to the development of “neoliberalism” as an explanatory mechanism for the reemergence of a market-oriented sensibility. Those who use the term have tended to assume the existence of a relatively stable neoliberal tradition, and to imply that a course can be charted between a set of theorists and a subsequent process of political and institutional change. This unitary narrative has been adopted by politicians and journalists as well, in service of attempts to identify patterns of appropriation between academic ideas and contemporary politics. This paper seeks to historicize the term “neoliberalism,” and to disaggregate its early development, by looking at several figures who are often cited as crucial to its emergence between the late 1940s and the early 1960s, including Ludwig von Mises, Friedrich Hayek, Milton Friedman, and Ayn Rand. It argues that disputes over method among these theorists are crucial to understanding the disjunctions between their social philosophies that, in many cases, they believed to be irreconcilable. Further, these methodological differences help to explain the very different patterns of appropriation of their ideas, as some saw their arguments lose the support of all but small circles of devoted acolytes while others came to exercise a broad influence in both popular politics and the academic social sciences. Finally, the paper examines how and why this complex and often intensely conflicted landscape has so often been rendered homogenous in recent academic and political debates.

S084-B

Mon 22 July, 14:00–15:30 ▪ Roscoe 2.4

Chair: Mark SOLOVEY | University of Toronto, Canada

Beatrice CHERRIER | University of Caen, France

East side story? How the ‘urban crisis’ framed urban economists’ identity, 1965-1974

As the “urban crisis” hit major American cities in the sixties, the nascent field of urban economics was still struggling with its identity. In the previous decade, Ressource for the Future had funded and coordinated economists’ efforts to explain metropolitan growth (size and distribution of activities and income, rents, transportation) with a variety of tools, ranging from input-output analysis to consumer choice theory. Yet, the relationship to neighboring subfields (regional economics), sciences (architecture and engineering) and broader interdisciplinary ventures (urban studies and city planning) was not stabilized. In the wake of the 1963-1965 riots, new questions and fundings flowed from governmental

agencies and foundations, with the aim of understanding and curing crime, racial segregation, poverty, congestion and pollution, and replacing ghettos with “model cities.” This paper shows how such social demand for new visions and policies impacted the formation of urban economists’ identity. It described economists’ diverging views of the relevant subjects, methods and boundaries of urban economics and the right level of participation to political decisions and policy making. Most visible on the public scene were those economists loosely related with the Chicago school of economics. They borrowed both from the imperialistic application of choice theory and the Chicago applied tradition in agriculture and econometrics, not only to formulate practical solutions to the new diseases of American society, but also to frame a political discourse. Such venture was challenged, in scope and content, by economists from the East coast, albeit with various purposes and styles. At Harvard, economists from various disciplinary backgrounds attempted to shape interdisciplinary and integrative plans to transform the Boston Area and to create institutions and curricula for their discipline. The MIT setting exhibited a division between those researchers willing to use insights from other subdisciplines (labor, development and growth economics) to meet specific practical demands from reformers, and those who worked on a general framework based on general equilibrium models and insisted to stay aloof from political and policy debates.

Tiago MATA | University of Cambridge, United Kingdom

The age of shock: radical journalism and political economy in seventies America

The 1970s saw a growth of pages covering financial and business news in USA media. By the end of the decade all metropolitan newspapers carried business sections and had significantly increased their specialist staff in the subject. The motive for this expansion was anxiety. If the 1960s can be sketched as an age of social and cultural shock, the 1970s were years of economic shock: rising inflation and failing purchasing power, loss of competitiveness and de-industrialization, and international monetary turbulence. Against this backdrop, a radical movement of economists found a second calling in journalism. With a first issue in November 1974, *Dollars and Sense*, a monthly bulletin of economic affairs, was the project of the Union of Radical Political Economics. Its stated mission to ‘offer clear and concise interpretations of current economic events from a socialist perspective.’ *Dollars and Sense* had personal and intellectual ties with the New York based *Monthly Review*, another magazine of socialist interpretation. However in format and content *Dollars and Sense* was always closer to the underground press of the sixties. The magazine was intended as a tool for activism. It carried the conviction that a discourse that was economically informed could also be politically compelling and responsive to the demands of advocacy. My paper examines how *Dollars and Sense* sought to accomplish a connection to its imagined public, and what answers to the questions of the day emerged from its outreach.

Wade PICKREN | Ithaca College, United States

Social scientists, public housing, and urban renewal in American cities, 1945-1965

Public housing and urban renewal represented two distinct efforts to change urban living patterns. First known as district replanning, urban renewal represented the desires of urban business owners, realtors, banks, and other corporate interests to improve property values and recapture potentially valuable land around downtown business districts. The public housing movement emerged in the 1930s as a coalition of social workers, intellectuals, religious leaders, and politicians who lobbied for Federal support for public housing. Their efforts led to the Housing Division of the new Public Works Administration (PWA-created 1933) which was charged with responsibility for housing for low-income families. These two groups were antagonistic in their aims, but cooperated to support the Federal Housing Act of 1949. The implementation of the 1949 legislation and its successor, the 1954 Housing Act changed patterns of living for millions of Americans and led

to the adoption of the term Negro removal as one indication of those changes. In this paper, I focus on the research and policy recommendations of social scientists in the twenty years from 1945 to 1965. The intellectual endpoints for the study are taken from Black Metropolis (1945), the sociological analysis of Black progress and obstacles to progress in Chicago, and Dark Ghetto (1965), psychologist Kenneth B. Clark’s meditation on the failure of the “good intentions” of well-meaning white liberals and policy makers in regard to race and inner city life.

S084-C

Mon 22 July, 16:00–17:30 • Roscoe 2.4

Chair: Alexandra RUTHERFORD | York University, Canada

Peter HEGARTY | University of Surrey, United Kingdom

Whatever happened to homosexuality and the Rorschach?

The shift from a disease model of homosexuality to the view of lesbians and gay men as a stigmatized group targeted by homophobia is one of the most dramatic shifts in the ideology of the social sciences in the late 20th century. Evelyn Hooker’s 1957 challenge to the “projective hypothesis” that a signature homosexual personality could be discerned from responses to the inkblots ambiguous figures is often credited with ending a widespread belief that the Rorschach test could diagnose homosexuals. Her paper is pivotal to this narrative in which social psychology – rather than clinical psychology – comes to define homosexuality in the discipline of psychology.

This paper aims to complicate this celebratory narrative by examining where the relationship between homosexuality and the Rorschach returned in the emerging science of social psychology, and how that relationship became forgotten, in the decades after Hooker’s critique. In the early 1960s, Dana Bramel examined men’s likelihood to project homosexuality onto Rorschach responses of others in cognitive dissonance studies. Later that decade, belief in the projective hypothesis around the homosexual personality was used by Lauren and Jean Chapman to ontologize stereotypes and clinical biases as the workings of a cognitive mechanism called the “illusory correlation.” However, social psychologists have written both studies out of the historical memory of the field for reasons that pertain to ethics, and the prioritizing of studies of racial prejudice over homophobia. There were only a handful of studies examining homosexuality and the Rorschach prior to Hooker’s work, and that work did not definitively excise the projective hypothesis from the psychology of homosexuality. Rather, Rorschach researchers into the 20th century debated the validity of ‘homosexual signs’ even into the 21st century. Even after depathologization, the Rorschach remained associated with homosexuality as researchers explored projective hypotheses around schizophrenia, HIV/AIDS and gender nonconformity and transsexuality.

Michael PETTIT | York University, Canada

The great cat mutilation

The paper examines the controversy over Lester Aronson’s experiments on the sexual behaviour of cats at the American Museum of Natural History (AMNH). Since the 1930s, Aronson had dedicated his career to examining the psychobiology of sex in different species. Initially working on fish and amphibians, since the late 1940s he ran an NIH-funded program on cats which investigated the effects of rearing conditions, castration, and brain lesions. In 1976, the resurgent animal liberation movement led by Henry Spira made the AMNH experiments one of its earliest successful targets. Although the scientific consensus was that Aronson was not *particularly* cruel or abusive towards his animals, Spira selected the AMNH due to the visibility of the institution, the pet-like status of the animals involved, and the seeming perversity of studying non-human sexuality.

Drawing inspiration from Robert Darnton's famous essay on cultural worlds, the paper will contextualize the controversy in terms of the changing meaning of utilitarian ethics in justifying experiments on animals. In part, the public redefinition of "surgeries" as "mutilations" reflected an encounter between the behavioural sciences and social movements. The various civil rights movements of the late 1960s had made Americans more sensitive to differing experiences of suffering. Spira and his followers were inspired by the bioethicist Peter Singer's revival of a utilitarian ethics of universal organismic suffering across the lines of species. The episode was also emblematic of the emergence of a neo-liberal ethos in science. Invoking the rhetoric of the 1970s tax revolt, animal liberationists attacked Aronson's ability to conduct disinterested, basic research with no immediate biomedical application. Moreover, to arbitrate the dispute science journalist Nicholas Wade turned to a new technology – Eugene Garfield's impact factor – to evaluate the merit of Aronson's cat research based on a utilitarian calculus of citations. Without denying the violence involved in Aronson's experiments, I argue that an exclusive focus on reading the controversy through the lens of the utilitarianism obscures what ethics animated Aronson's research. The result was a historical forgetting of the queer biopolitics around animal sexual behaviour that existed at the AMNH from the 1930s to the 1970s.

Mark SOLOVEY | University of Toronto, Canada

The Institute for Policy Studies: reconstructing social inquiry and social inquiry for reconstruction in the United States since the 1960s

Starting in the 1960s, critical liberal and more committed leftist scholarship in the social sciences and related humanistic fields of study expanded dramatically in the US. Yet obtaining funding from major extra-university patrons for such work remained difficult, partly because of the long-standing quest among scholars and their patrons for scientific legitimacy, which had often entailed a strong commitment to value-neutrality and a rejection of politicized and ideological forms of inquiry. Such a stance received support from many powerful patrons, including the National Science Foundation (a civilian agency), the Defense Department, and the large private foundations including Ford, and from major think tanks and research institutes, such as the RAND corporation and the Brookings Institution. Yet leftist scholarship did acquire support during the last third of the twentieth century from the Institute for Policy Studies (IPS), which during this period became, arguably, the most prominent and influential think tank on the ideological left. In his 1971 study *Think Tanks*, the prolific journalist Paul Dickson noted that though the Institute was not even a decade old, its impact on the political Left was already "considerable." A decade later, the distinguished writer and outspoken critic of US imperialism Gore Vidal suggested that while for many Americans it was a point of pride that they lacked a political ideology, "thoughtful citizens" had also begun to realize that the nation was lacking "political ideas." It was thus fortunate that the IPS was encouraging scholars to revive American politics with their creative ideas. And of special interest to the present paper, in the early 1990s historian James A. Smith claimed that the IPS's efforts to link ideas to action helped to mark the emergence of a new orientation in the world of think tanks, one that rejected a stance of disinterested and objective analysis in favor of explicitly partisan and value-laden inquiry. This paper examines the effort by IPS left-leaning architects to establish a program for the reconstruction of social inquiry in a manner that would facilitate the social reconstruction of society along lines they favored. Though various scholars were involved in this effort to rethink the social sciences, the most important figure in my analysis is Marcus Raskin, one of the Institute's founders and long-time leaders.

S086. Data at work

Sponsoring body:

SIGCIS: Society for the History of Technology
Special Interest Group on Computers, Information and Society

Mon 22 July, 14:10–17:40 ▪ Uni Place 2.219

Symposium organisers:

Miguel GARCIA-SANCHO | University of Edinburgh, United Kingdom

James SUMNER | University of Manchester, United Kingdom

Symposium abstract

The project to move IT history beyond narrowly internal technical narratives, while now established, is far from complete. We offer a contribution here by focusing, not on "computers", but on data structures and information processing in their relationship with various "real worlds" of working activity.

A. Biology, agriculture and medicine

Computer data has gained a privileged position in the biological and biomedical sciences over the past 60 years. This session explores the professional and practical aspects of data use in medical and biological research centres. We address a range of cases, from early use of computers in the investigations on the genetic code to centralised services for clinical trial data, to the more recent development of biomedical databases by professional curators. Spanning the second half of the 20th century, we will integrate history, philosophy and STS perspectives. An underlying theme of all the papers is a challenge to widespread characterisations of the application of computers and data concepts as a straightforward process.

B. Making coding cultures

Computing systems require rigidly formalised specifications at various levels; formalisms seldom interface easily with the "real world". Much the same can be said of the rousing rhetoric of root-and-branch change which often accompanies IT initiatives. From international attempts to negotiate the working of a common language in the 1960s, to invocations of the potential of a "nation of coders" both in the 1980s and today, this session maps some of the complexities of being programmatic about programming.

S086-A. Biology, agriculture and medicine

Mon 22 July, 14:10–15:40 ▪ Uni Place 2.219

Chair: Niki VERMEULEN | University of Manchester, United Kingdom

Miguel GARCIA-SANCHO | University of Edinburgh, United Kingdom

Writing the history of 'computers' and 'data' through their interactions with biomedical research: from the genetic code to DNA sequencing (1950s-1980s)

In this presentation, I will argue that computers and the data they produce should be approached as historical entities, in order to properly address their interactions with biomedical research. I will present three chronologically consecutive case studies in which the available computers at each time crucially shaped the type of data biomedical scientists obtained and the way they organised their research networks.

In the late 1950s and 60s, researchers working on the genetic code used mainframe computers to test different hypothetical models of interaction between genes and proteins. This led them to conceptualise this interaction as an input-output process inspired by the mechanisms which

governed the internal architecture of mainframes at that time. The linear-straightforward model of interaction between DNA and proteins which resulted from that conceptualisation has long survived the use of mainframe apparatus.

Towards the late 1970s biomedical research centres gradually introduced minicomputers, which were located in specific rooms and shared by biologists and personnel in charge of the programming and technical support. This eased cooperation between the two types of workers and strengthened a new category of data: strings of interconnected characters, such as DNA sequences, which were inputted into the computer by the user.

The next decade, in the 1980s, the first DNA sequence databases were created in microcomputers, smaller and cheaper apparatus adapted to individual laboratories or offices. This led to the recruitment, by biomedical centres, of independent teams of systems engineers in charge of database design. The systems engineers modelled the database architecture on networks which connected the DNA sequences with various multilayered features. They also faced adaptation problems, due to their lack of interaction with the user biologists working at the same research institutions.

Joseph NOVEMBER | University of South Carolina, United States

The Cochrane Collaboration, beyond Cochrane

The Cochrane Collaboration provides medical research information in digital form to healthcare providers around the world. Though the Cochrane Collaboration's resources, particularly its database of systematic reviews, are now widely used, little has been said about the motivations for the organization's founding. This paper will look beyond the popularly repeated story, particularly among practitioners of evidence-based medicine (EBM), that the Cochrane Collaboration was founded in direct response to Archie Cochrane's early 1970s calls to provide global access to randomized controlled clinical trials (and their results), and towards the institutional and technological forces that generated demand for the organization's services.

Hallam STEVENS | Nanyang Technological University, Singapore

Generating value: the Ensembl database and the dynamics of data

In 2008, Kevin Kelly, founding editor of *Wired* magazine, argued on his blog ('Better than free': http://www.kk.org/thetechnium/archives/2008/01/better_than_fre.php) that the web had fundamentally changed what would count as valuable in the future. Since the Internet is very good and making and proliferating copies of information ("The Internet is a copy machine."), copies become more or less worthless: information becomes free. According to Kelly, what remains valuable is that which cannot be copied: immediacy of access, personalization of data, interpretation of information, authenticated information. Although Kelly was writing about economic value, the notion of the Internet as a giant copy machine has consequences for knowledge too. In the world of Big Data, what counts as valuable will be highly accessible, readily searchable, and easily interpretable.

This paper will draw on interviews and fieldwork at the European Bioinformatics Institute (EBI). The EBI's Ensembl database will be used to explore how data is manipulated and ordered in order to become *valuable* for biological work. The Ensembl team itself conducts no experiments, produces no raw data. Yet its work is highly valued by biologists because of its contribution to organizing data. The particular ways in which Ensembl structures and organizes information are considered to be its trademark and its greatest asset.

Much of the bioinformatic labor that constitutes Ensembl is the appropriate movement of data in virtual space. It is through the motion and organization of data in virtual space data becomes valuable. A

disordered or haphazardly organized space would be of no value because it would reveal nothing about biology. Thus the way data is moved around in space and the way it is arrayed in space determines its epistemological status – data that is appropriately ordered in virtual space can attain value.

Kelly's insights can help us to understand these new regimes of value surrounding data in biological work. The process through which information becomes authenticated knowledge is being transformed by the very fact that a vast amount of data is so cheaply and easily circulated. The careful management of virtual space creates ordered, searchable, accessible, reliable, and interpretable information. In other words, this organization of data in space provides a means through which data can become knowledge.

Sabina LEONELLI | University of Exeter, United Kingdom

Putting data to work in plant science, 1990-2012

This paper examines the ways in which the plant science community, in collaboration with other communities of researchers in biomedicine, has re-organised its research practices and infrastructures to enable the intelligent re-use of data over the last 25 years; and how the development of infrastructures and forms of governance aimed at circulating molecular data has affected the ways in which biologists today think about what it means and what it takes to transform large quantities of data into scientific insights. I first examine how the introduction of genome sequencing in the 1990s provided an excellent opportunity for biologists to start re-structuring their means of exchanging molecular data, and devise institutional mechanisms, infrastructure and relevant expertise that would facilitate data-intensive discovery. These initiatives include societies like GARNet and data curation initiatives such as the Plant Ontology, and are very heavily structured around the study of one plant species, *Arabidopsis thaliana*, as a reference organism. I then discuss how these initiatives have had two seemingly contrasting effects on contemporary plant science. On the one hand, they have boosted interest in so-called Open Data initiatives particularly in the UK, thus fostering attention to the dissemination and re-use of data well beyond the molecular level and single species (e.g. data about the physiology, metabolism, morphology and ecology of a large variety of plants). On the other hand, they have put molecular data, and particularly high-throughput data from the genomics, proteomics and metabolomics of *Arabidopsis*, at the centre of data-intensive research, thus transforming one specific type of data on one specific type of organism into an obligatory passage point to study the natural variation, biodiversity and ecology of plants.

S086-B. Making coding cultures

Mon 22 July, 16:10–17:40 • Uni Place 2.219

Chair: James SUMNER | University of Manchester, United Kingdom

Liesbeth DE MOL | Ghent University, Belgium

From the machine's eye? ENIAC and its different users

ENIAC, the electronic numerical integrator and computer, announced to the public in 1946, is one of the most famous "first" electronic general-purpose computers. It is also a transitional machine: unlike our modern concept of a computer, the original ENIAC had no real programming interface. In order to set up a problem on the machine it had to be manually wired: this was considered as one of two major bottlenecks (the second being memory) that was in need of a solution (and which was partially solved after the rewiring). The machine, before its rewiring, was also very modern as compared to the EDVAC design because of its highly parallel character, a property which made it even more challenging to "program" the machine. Even though access to the ENIAC was highly restricted, quite a different number of researchers worked with it and had their problems run on it. The physical

contact/meeting between this special and difficult machine and different types of researchers resulted in quite different views on computing. The aim of this talk is to discuss the ENIAC experience from the point of view of three of its users: John von Neumann (mathematician and "homo universalis"), Derrick H. Lehmer (number theorist) and Haskell B. Curry (logician). Each of these researchers had quite explicit and different views on what coding and programming could be like. It is shown how their meeting with ENIAC played a significant role in the formation of those views. The fact that the experience with the same machine by different people results in so different views not only illustrates the significance of the particularity of a concrete human-machine interaction, but also supports the view of the multi-faceted and general-purpose character of ENIAC.

Thomas HAIGH | University of Wisconsin-Milwaukee, United States

Rethinking the stored-program concept

Thirty years ago, as the history of computing began to develop as an academic field, its practitioners agreed that adoption of the "stored program concept" was the crucial dividing line between modern computers and the machines that preceded them. This judgment has been little questioned since.

However the literature shows no such unanimity on what the stored program concept actually is, and its relationship to other concepts such as a "general purpose," "practical" or "universal" computer. Implicit definitions entail more than simply "storing" a program, but the core package of features varies between authors. The primary advantage offered by the concept is sometimes seen as one of theoretical computational power and sometimes one of engineering practicality.

This paper is a first step toward reinterpreting "stored program concept" as an idea with its own history, evolving over time in the service of a number of distinct agendas and in the hands of a number of distinct social groups. It sketches three periods. The first is the immediate reception of the ideas contained in John von Neumann's "First Draft of a Report on the EDVAC" (1945). This is invariably cited as the seminal expression of the stored program concept, though it does not include the phrase "stored program" or even the word "program." A variety of advantages were attributed to "EDVAC-type" machines by early authors and the presenters at key computing meetings, the most important being the promise of a flexible computer with many fewer vacuum tubes than otherwise required.

During the 1950s, the second period examined, the phrase "stored program" began to enter use. Archival research suggests that it originated within IBM in 1949. For an experimental hybrid machine with two distinct programming mechanisms it distinguished the program loaded into electronic memory from the one wired onto a plug board. Early usage in the published literature was predominantly by IBM representatives.

It achieved its current prominence only in the late-1970s and early-1980s. Its appeal to historians of computing was as a means of putting to rest bitter and unproductive feuds about the identity of the "first computer." A kind of truce was reached, as each early machine was awarded a set of qualifying adjectives such as "general purpose," "electronic" or "full scale." The "stored program concept" was articulated clearly enough for this purpose, but never really defined clearly enough to be a satisfactory analytical tool.

My conclusion is that the concept has been overloaded with too many different meanings to be salvaged for analytical use. Instead I define a more precise alternative, the "modern code paradigm" to describe crucial ideas on code format and capabilities from the 1945 report. I separate this from two other crucial aspects of the 1945 report: the von Neumann architecture and the EDVAC hardware paradigm.

David NOFRE | Independent scholar, Netherlands

The promises and problems of a universal programming language: reconciling scientific inquiry and technological stability in the ALGOL project, 1960-1965

In the early 1960s ALGOL was expected to become a universal programming language for scientific computation, equally suitable for publication of algorithms and for allowing their automatic execution on every computer. ALGOL represented a radical shift in the way computer programming was understood up to that point, establishing the basis of our current understanding of programming. However, the various versions of the language failed to reach widespread implementation and the project crumbled in the late 1960s. Making extensive use of archival sources, this paper seeks to explore the reasons behind such contradictory outcome and in addition review the popular portrayal of ALGOL as an idealistic approach to programming, victim of IBM's vested interests on its FORTRAN language. In particular, we aim to show how the various international and national organizations that lent their support to the ALGOL project proved unable to agree on ways of reconciling the open character of the language as a scientific object with the need to deliver a stable, marketable product.

This tension became particularly evident in the complex relationship of IBM to ALGOL. In 1958 the first version of the language –product of collaboration between scientists from both sides of the Atlantic– received the support from several organizations in Europe and the US, including IBM's users group SHARE. Initial attempts to implement the language, however, revealed the existence of ambiguities in language definition and the complexity of getting an ALGOL processor to work. In 1960 the second definition of the language introduced so many new features that it was perceived by many as an entirely new language. As a result, IBM and SHARE decided to cool down their support for the project until it was agreed on an international body to act as official arbiter on ALGOL. In the next years the project moved within the newly established IFIPS, but preference for knowledge generation remained a priority. Eventually, this epistemic aspect of the language became a difficult hurdle to overcome in trying to find a compromise with IBM, which was also facing the appearance of COBOL, a business language sponsored by the US government. Still, ALGOL proved to be a crucial step in the rise of computer science as discipline, as aspects like its machine-independent character, the ambiguities in language definition, or the challenge of developing processors became soon productive venues of research.

Tilly BLYTH | Science Museum, London, United Kingdom

De-coding public service: the production and consumption of cultural values in the BBC microcomputer

The BBC Microcomputer has long been represented as an educational computer that changed the landscape of information technology in British schools during the 1980s. Its story of innovation is characterized as one of a small Cambridge spin-off that joined up with the BBC and government departments to create a new culture of educational computing in Britain.

This paper suggests that an STS analysis, that brings together artefacts, organisations, users and mediators, not only illuminates the culture of programming that supported the co-construction of multiple user/producer identities, but also enables scholars to move beyond an understanding of producers with a purely economic imperative to those with cultural values and a public service agenda. Like many other personal computers, the BBC Microcomputer reflected a desire to instil its users with an intellectual curiosity and a sense of creative entrepreneurialism. The involvement of a state broadcaster in its production makes these values explicit in the way the artefact was co-produced and consumed in homes and schools.

This perspective is particularly relevant in the current climate, with government and industry calls to inspire a new generation of programmers. 25 years on the BBC Microcomputer has a long life

history – with dedicated users that keep alive the hardware and software. There are even hopes for an afterlife through the Raspberry Pi, that captures these Reithian values in new hardware with a fresh generation of programmers. But does this type of technological innovation require a sense of public service at its heart?

S087. Science and the emotions: transnational and interdisciplinary perspectives

Tue 23 July, 09:00–15:30 • Roscoe 1.009

Symposium organisers:

Javier Moscoso | Centro de Ciencias Humanas y Sociales, Spain

Marga VICEDO | University of Toronto, Canada

Symposium abstract

Emotions have become a subject of considerable research in the last thirty years. Historians, philosophers, and scholars in literary and cultural studies have contributed extensively to a growing body of literature exploring different conceptions of emotions in different periods. Historians of science have not participated as fully in this emotional turn yet. In the history of science, most of the work has focused on the role of emotions in shaping science and the scientific self. The participants in this multi-session symposium aim to explore further how science has also played a key role in shaping views about the emotions. Examining scientific research on emotions will help uncover how different societies conceptualized the emotions and the influence of scientific ideas on changing views about different emotions. Scientific knowledge of the emotions has been put to work in diverse ways: shaping the moral and social valuations of different emotions, influencing social debates about the relationship between individual personality and social order, and, generally, influencing changing conceptions of human nature.

S087-A

Tue 23 July, 09:00–10:30 • Roscoe 1.009

Chair: Marga VICEDO | University of Toronto, Canada

Edmund RAMSDEN | University of Manchester, United Kingdom

The animal laboratory as clinic: W Horsley Gantt's studies of experimental neurosis

Inspired by the work of Ivan Pavlov, and seeking a scientific approach to human psychopathology, from the 1930s, American psychiatrists turned to the animal laboratory. Experimental neurosis could be reliably generated in a variety of animals – most commonly dogs, but also sheep, goats, pigs, and cats – by changing the conditioning routine and creating irresolvable conflict between stimuli. From the 1960s, however, the study of experimental neurosis was criticised for being too artificial in method, lacking in interpersonal and social context, and the disorders created too readily mapped onto the human. Focusing on the work of W. Horsley Gantt at Johns Hopkins, this paper will revisit the use of the conditional reflex method in the study of experimental neurosis. It will show how Gantt was, firstly, less concerned with modelling a specific syndrome, than a functional relationship between emotional disorder and its physiological bases; and secondly, was acutely aware of social factors such as the relationship between dog and human experimenter. Gantt observed individual dogs throughout their lives and took account of their personalities and social relationships. We will explore the influence of his case-based approach in behaviour therapy and clinical

medicine, and examine the problems it generated for the growing field of experimental psychopathology.

Javier Moscoso | Centro de Ciencias Humanas y Sociales, Spain

Resentment, monomania and modernity

This presentation will attempt to draw some lines between the cultural history of emotions and the political history of psychiatry. Resentment, on the one hand, and monomania, on the other, will serve me here to explore the cultural forms of modern subjectivity, the conditions that made possible both the salience of a particular mental disorder and the intellectual reflection on a highly sophisticated social passion. I will argue that resentment and monomania came about in the same cultural and political space, and that, in a sense that will be explained later, none of them could have developed without the presence of the other my approach does not share the tenants and assumptions of the seminal work of Marc Ferro. Unlike this French historian, who defended that resentment was a key and constant element in the revolutionary processes of any type and of any period, from the Antiquity to Contemporary Societies, I consider resentment a passion of modernity, whose first systematic treatment was provided by Adam Smith in the mid 18th Century, and whose hutching depended on highly embedded social roots.

With regard to the history of monomania, I do share some assumptions with the recent and not so recent readings in the social and cultural history of mental disorders. The works of Jean Goldstein, Marcel Gauchet and Gladys Swain have confronted some of the connections between mental illness, subjectivity and modernity. More recently, Laure Murat, in the *L'homme qui se prenait pour Napoléon* has also drawn interesting suggestions regarding the political history of monomania before and after the events of the French Revolution. My approach, however, also differs from theirs in that my reading is primarily concerned with the relation between distorted experiences and inflated passions. I am not so much interested here in the layers of the modern identity, as Goldstein did, or in the romantic bio-politics of the self, as Gauchet and Swain proposed, following Foucault. My intention is shed some light on the historicity of human experiences and, in more in particular, in the salience of moral and political resentment. This historical epistemology of experience, as I would like to call it following the work of Lorraine Daston, Ian Hacking or Arnold Davidson, will lead me to suggest, in the case of resentment, few cognitive conditions that made its formulation and inclusion within a theoretical framework possible.

Elizabeth LUNBECK | Vanderbilt University, United States

Aggression and fear in the modern workplace

The dysfunctional workplace, ruled by the controlling, manipulative, and abusive boss, is a staple of our popular culture as well as the object of sustained investigation by scholars in a variety of disciplines. The misery occasioned by bullying bosses is all over the internet, and observers have long documented the cost of the same to companies, organizations, and economies. Yet the workplace continues to serve as a site for the expression of aggression and casual brutality despite our ever-more-refined characterologies and interventional strategies.

In this paper, I examine this recalcitrant issue, focusing on a fundamental ambivalence about the leader's character as sketched by psychologists, psychoanalysts, and other students of management and leadership. In this literature, the leader's charisma, creativity, and even authoritarianism are deemed essential but also of a piece with the callousness, paranoia, and destructiveness that bring organizations to ruin. This ambivalence finds support in the wider culture, which celebrates a risk-taking grandiosity in leaders that is at odds with calls for supporting employees' autonomy and recognizing their competencies.

I then examine the organizational writings of the psychoanalyst Otto Kernberg, who chronicled the “sadism, corruption, and envy,” all forms of “rationalized aggression,” that in his view coursed through social and organizational life. Kernberg’s work has proven foundational to studies of the workplace and its deformities. “The more cautious and refined manifestations of human aggressiveness” that Freud, in *Civilization and Its Discontents*, cast as beyond the law’s reach formed the stuff and substance of Kernberg’s dystopian vision. His gallery of pathologically narcissistic types and his catalogue of the ways that we as humans make one another miserable resonates with the well-known dictum that for moderns “hell is other people.” I conclude by assessing the foundational nature of Kernberg’s contributions to studies of our undercivilized selves in the modern workplace.

Kira LUSSIER | University of Toronto, Canada

Temperament at work: the Humm-Wadsworth Temperament Scale in Depression-era America

Writing in *Nations’ Business* in 1939, Doncaster Humm marketed his recently published psychological test, the Humm-Wadsworth Temperament Scale (HWTS), as a scientific tool that would help businesses select the right person for the right job. Through questions ranging from ‘Do you like movie heroes?’ to ‘Is a disappointment more likely to make you angry than sad?’, the HWTS promised to screen out problem employees and select for talented employees. Between its initial publication in 1935 and World War II, over two million people took the test, most often through workplace personnel departments in companies like Lockheed Martin and Western Electric. What can account for the HWTS’s initial popularity, at a time when many psychological tests were met by industry skepticism? What was it about temperament that appealed to management? And why should anyone care about an old obsolete psychological test? I argue that crucial to the HWTS’s success were Humm and his co-author Guy Wadsworth’s aggressive marketing strategies, bolstered by their respective scientific and corporate credentials, and a hospitable corporate climate. Both Humm and Wadsworth actively tried to shape the scholarly, business, and popular debate around the test, publishing in journals of academic and applied psychology, personnel journals, and popular newspapers and magazines. The backgrounds of Humm, a psychologist who had researched the heritability of mental disorders, and Wadsworth, a corporate vice-president of personnel, allowed them to ground the test’s claims in both scientific knowledge of temperament and management talk of efficiency and productivity. The test’s adoption was deeply rooted in the context of American labor relations of the 1930s, which saw increasing strife between management and labor. Since the 1935 Labor Relations Act, management was prohibited from directly asking employees about union sympathies and using that information as basis for personnel decisions. The HWTS’s claims to screen out maladjusted workers was a persuasive marketing strategy, as both psychologists and business executives equated maladjusted workers with union agitators, socialists, and political radicals. The HWTS remains little known by psychologists, historians of science, and the general public. But as I will argue, the test’s development, focus on temperament and use by management reflect an important part of the history of applied psychology and labor relations in America.

S087-B

Tue 23 July, 11:00–12:30 ▪ Roscoe 1.009

Chair: Michael PETTIT | York University, Canada

Nadine WEIDMAN | Harvard University, United States

Konrad Lorenz, Desmond Morris, and the ethology of emotion

I will consider ethology, the science of animal behavior, as a science of emotion. Lorenz and Morris, both pioneers in and popularizers of the science in the 1960s, theorized that male aggression was the central

instinctual force in constructing animal society, and that humans should become aware of the role of aggression in their own lives. I will argue that their science constructed emotion as basic and biological, as the link between animals and humans, and as a window into human instincts; the centrality of emotion in also helped them make ethology a value-laden critique of both a technoscience and a civilization grown too far out of touch with human nature.

Rhodri HAYWARD | Queen Mary, University of London, United Kingdom

The age of anxiety and the rise of depression

Since the 1960s many epidemiologists and psychiatrists have commented on the relative decline in incidence of anxiety disorders and the concomitant rise in diagnoses of depression. Most commentators have explained this change through reference to the determinative power of the pharmaceutical market. This paper argues for a broader explanation of this transformation. It demonstrates how the meanings of anxiety and depression were transformed through the rise of animal experimentation and evolutionary psychology. Examining the work of a group of psychiatrists and clinical psychologists centred around the Maudsley Hospital in London, I try to show how the discovery of an evolutionary dimension to mental illness has made possible new kinds of psychiatric intervention and new forms of political action.

Susan LANZONI | Harvard University, United States

Technologies of the self in relation: empathy in psychology and American culture

This paper tracks an evolving technology of empathy with roots in the work of the philosopher and social worker Jessie Taft and the Pennsylvania school of social work in the 1930s, culminating in the client-centered psychotherapy of psychologist Carl Rogers in the late 1940s and 1950s in North America. This interpersonal method saw the counselor’s role as the reflection, understanding and acceptance of the expressed emotions of the client. By the postwar period, empathy entailed the counselor’s active immersion in the client’s frame of reference while at the same time refusing judgment or the simple affixing of diagnostic labels on the client. Although developed in the context of professional helping relationships in social work and clinical psychology, the molding of the self in the practices of empathy was closely conjoined with the philosophical and political values of social reform, and anti-authoritarian and democratic ideals. The virtues of empathy were popularized in the post war period, and extended to family life, intercultural understanding and even consumer relationships. Following the changing meanings of empathy demonstrates how the intimate emotional ground of psychotherapy and counseling was at the same time a locus for more expansive social concerns in this period.

Eric M. JOHNSON | University of British Columbia, Canada

A historical epistemology of empathy from Darwin to de Waal: primates and perspective-taking after World War II

Much overlooked in Darwin’s theory of natural selection is his argument for the origin of social instincts that gave rise to shared common feelings between animals in a group. For Darwin, the “moral sense” had its foundations in the pleasure an animal felt from their social community and their identification with the internal state of others, or perspective-taking. From this followed the emergent instinct to “perform various services for them,” a trait that was promoted through natural selection when groups with a high level of reciprocation “would flourish best and rear the greatest number of offspring.” This concept subsequently formed the basis for Peter Kropotkin’s 1902 work *Mutual Aid: A Factor of Evolution*, first appearing as a series of articles in *The Nineteenth Century* beginning in 1890, and culminating in his posthumous work *Ethics: Origin and Development* in 1924. Both Darwin and Kropotkin emphasized that adopting the perspective of another was a natural evolutionary strategy and formed the basis for the modern conceptions

of social duty and justice. However, the work on this question by early twentieth-century philosophers and psychologists was stymied by a lack of precision and an emphasis on Freudian interpretations that resisted empirical verification. It was only in the post-war era that experimental psychologists such as Robert E. Miller, Jules Masserman, and Stanley Wechkin systematically investigated perspective-taking in captive primates to provide the theoretical distinctions and empirical foundations that these humanistic disciplines lacked. In a series of papers published between 1959 and 1964, the evolutionary basis for empathy posited by Darwin and Kropotkin was given empirical support when monkeys were found to recognize the facial expression of distress in others and acted to reduce their pain, even at a cost to themselves. During the same period in which the humanities and social sciences were turning away from Darwinian interpretations of human behavior, it was those who returned to Darwin that empathy was revived as a serious academic subject.

S087-C

Tue 23 July, 14:00–15:30 ▪ Roscoe 1.009

Chair: Mark SOLOVEY | University of Toronto, Canada

Bonnie EVANS | King's College London, United Kingdom

Why autism? Child psychiatry, the law and the formation of a new research programme in 1950s and 1960s Britain

In the 1950s, British researchers in child psychology and psychiatry began to challenge the law concerning the institutionalisation and treatment of children with severe mental illness using the concept of 'autism' as their guide. This paper shows how clinicians and researchers such as Elwyn James Anthony, Mildred Creak, Victor Lotter and Michael Rutter laid the foundations for current autism research in the U.K. These researchers critiqued the therapeutic nihilism then existing concerning the treatment of severely mentally-ill children and developed new institutional and intellectual networks which championed the study of children's abnormal emotions and social awareness as a consequence of their 'autism'. Their radical reconceptualisation of the central tenets of child development led to major reforms in health and education policy for children with mental illness and these reforms continue to influence the way in which children's emotions are framed and understood in both social and scientific contexts. This paper shows how British researchers of the 1950s and 1960s worked simultaneously as both government advisors and scientists in order to develop a new context in which to understand psychological development in children and its abnormalities.

Marga VICEDO | University of Toronto, Canada

Becoming human: autism as metaphor in Bruno Bettelheim

In little over half a century, autism has gone from a little known and rare condition to be considered an epidemic in the United States. Understanding how this happened reveals much about changing views of human nature and the role of emotions in the formation of the self since WWII. In this presentation, I will focus on Bruno Bettelheim. Once heralded as a genius, he is now vilified as the most visible defendant of the view that rejecting mothers caused their children to retreat into autistic walls. Placing Bettelheim's work in its social and scientific context, including views about children's emotional needs, helps illuminate his powerful role in turning autism into a metaphor about contemporary social anxieties concerning the mechanization of personal relations and the dehumanization of society. Ever since Bettelheim, the history of autism, the history of emotions, and the history of the self have been deeply interconnected.

Gregory HOLLIN | University of Nottingham, United Kingdom

Constructing the social subject

The proposed aetiology of autism has been in constant flux since the disorder was christened in the 1940s. This flux has mirrored changes in the dominant psychological paradigm over the same time period. Initially a psychoanalytic perspective on the aetiology of autism was common, followed by the rise of behaviourist approaches (particularly with regards to intervention), and now cognitive psychology and neuroscience dominate the field. This paper will look at a short period of time (1985-1989) in which the modern conception of autism was formed by three new theories of autistic aetiology originating in cognitive psychology; executive dysfunction, metarepresentation impairment, and weak central coherence. It will be proposed that not only did our modern conceptualisation of autism crystallise in this very short period of time, but that this modern form is historically peculiar. Prior to 1985, as a socio-emotive disorder, autism had been understood to be inseparable from interpersonal relations. All three of the new cognitive theories rejected this view and made socio-emotive deficits purely symptomatic of an asocial cognitive impairment. It is proposed that this shifting aetiology reveals two important reconstructions of supposedly 'natural kinds': both autism as a disorder and 'the social' itself were fundamentally reconstructed in order to come under the gaze of cognitive psychology.

Stuart MURRAY | University of Leeds, United Kingdom

Autism and the posthuman

Because of the various differences – neurological, behavioural, cultural – which it embodies, autism offers a particular vantage point on the questions that surround the idea of what constitutes 'the human'. This can take the form of prejudicial discrimination when judged in terms of a disability 'deficit', but can also potentially offer a productive revision of ideas of self, agency and 'the human subject'. This paper will look at ideas of autism in relation to writing, critical/radical humanism, and particularly the emergence of the category of the posthuman; and will consider questions surrounding media, technology, clinical diagnosis and autism advocacy. Katherine Hayles has claimed that the posthuman condition is one marked by what she terms 'distributed cognition', which might seem to offer the possibility of a connection to an idea of autistic normality. The paper will weigh the competing claims of the categories of the posthuman, using the work of Hayles, Carey Wolfe, Rosa Braidotti and others, in order to further complicate our understanding of the condition.

S088. Expanding women's sphere: knowledge and the re-definition of women's work in the twentieth century

Sponsoring body:

DHST Commission on Women and Gender Studies

Wed 24 July, 09:10–12:40 ▪ Roscoe 2.3

Symposium organisers:

Rima D. APPLE | University of Wisconsin-Madison, United States

Rosemary WALL | University of Hull, United Kingdom

Symposium abstract

'Expanding women's sphere' explores the way in which women defined their work and role, often within strongly masculine environments - veterinary science, medicine and science. We have recruited speakers to illustrate women's strategies across varied disciplines. We propose six papers across two sessions, with 15 minutes per paper and 45 minutes for a commentary and a general discussion within each 90 minute

session. These papers have a trans-national perspective, mainly focussing on Britain and the USA, but also the activities of British and American women in China, Malaya and West Africa.

The first session will examine women's work in biological and health sciences from the perspective of the USA and the UK and will be followed by a commentary by Rosemary Wall, drawing connections between the three papers. The second session will situate the activities of American and British women working in health and science within an international context, beginning with ideas of public health and educational theory in the USA, followed by American and British incursions into education and practice in Asia and Africa. The session will be completed by a commentary by Rima Apple, linking together the papers in this session and drawing connections with the rest of the symposium.

S088-A

Wed 24 July, 09:10–10:40 ▪ Roscoe 2.3

Chair: Sally HORROCKS | University of Leicester, United Kingdom

Rima D. APPLE | University of Wisconsin-Madison, United States

Modernizing motherhood through science

Traditionally, women's experiences have formed the basis of respected mothering practice. As scientific and technical expertise gained in prominence throughout the 19th century, increasingly women were told that they needed to understand scientific and medical knowledge in order to raise their children appropriately and healthfully. This ideology of "scientific motherhood" was modified over the decades, as women were increasingly told that they needed to follow the lead of scientific and medical experts. In other words, rather than actively learning for themselves, women were to depend upon the instructions of scientific and medical authorities, primarily men. The health-care providers shaped maternal practice but it was not merely a case of physicians imposing their ideas on passive mothers. Women could and did resist physicians but significantly they used contemporary scientific and medical knowledge to do so.

Marsha RICHMOND | Wayne State University, United States

Women and scientific practice within experimental institutes of genetics, 1900-40

The rediscovery of Mendel's laws of heredity in 1900 launched a new era in the experimental study of heredity. Around the world, biologists began designing new research programs to study evolution using the new techniques of Mendelian breeding analysis. Because the universities were not well equipped to accommodate the needs of genetics, new private research institutes were created in the United States, Britain, and Germany devoted to the experimental study of heredity. Women were present in these institutes from the beginning. This paper explores the ways in which gender impacted the day-to-day work carried on in genetics laboratories, including interpersonal relationships, the organization of scientific labor, scientific communication, and the overall output of research programs. In focusing on the social, intellectual, and scientific dynamics of mixed-gender laboratories, I argue that the inclusion of women in the new experimental institutes in genetics between 1900 and 1940 ushered in significant changes in the organization of scientific research.

Julie HIPPERSON | Imperial College London, United Kingdom

Brains over brawn: women vets and the fight for clinical excellence in small-animal practice

When women first entered the veterinary profession in the 1920s it was widely assumed that their future, as distinct from that of the profession as a whole, lay almost exclusively in small animal practice. As the

'weaker sex', the male elite argued that women were unsuited to both the physical demands of work with large animals, including prestigious equine practice, and the stressful lifestyle associated with that type of practice. Instead they were expected to be contained within the relatively marginal field of 'pet practice', supposedly better suited to their small hands and caring natures. By embracing 'women's work' rather than seeking avenues into the traditional male strongholds, women vets in the three decades from 1922 were integral to demonstrating the utility of small animal work, its financial viability, as well as its unique clinical and surgical opportunities. This had important consequences for the profession. By the late 1950s the exceptional and unanticipated growth in small animal practice meant that it represented the bulk of the work undertaken not simply by women vets, but by the majority of the heavily male-dominated profession in England. This meant once denigrated 'women's work' had effectively become 'men's work'. This paper will look at how these changes were managed within the profession, to show how arguments designed to contain women within small animal practice were initially utilised by women and ultimately recast when men came to dominate the field.

Commentary: Rosemary WALL | University of Hull, United Kingdom

S088-B

Wed 24 July, 11:10–12:40 ▪ Roscoe 2.3

Chair: Aya HOMEI | University of Manchester, United Kingdom

Elizabeth TOON | University of Manchester, United Kingdom

Demonstrating expertise: women, public health, and education in the interwar United States

This presentation examines the work done by American women in health education in the 1920s and 1930s. In this era, leading health professionals agreed that future improvements in everyday Americans' health would be achieved through teaching children to apply hygienic and nutritional knowledge in daily practice. These professionals looked to women to do the work of translating and interpreting this knowledge. Many women took up this challenge, some by working with male public health leaders to create child-friendly health teaching materials, others by teaching everyday schoolteachers how to fit the 'new school health education' into their classrooms. This reached its peak in the interwar public health demonstrations funded by the Commonwealth and Milbank Memorial Funds, which set out to teach communities the value of public health, in part by helping those communities' children attain better personal health. My paper assesses how gendered expectations about women as teachers and communicators provided women working for initiatives like these with expanded career possibilities, as women's skills in 'interpreting' expert knowledge were increasingly demanded by public health.

Miriam LEVIN | Case Western Reserve University, United States

Science and social change: the case of Ginling Christian College for Women

The history of women's missionary colleges in China founded at the start of the 20th century suggests growing Chinese nationalism and political shifts welcomed western science. The case of Ginling College, Nanking, offers an opportunity to understand how colleges founded by American missionaries to provide education in English for Chinese women saw this situation as an opportunity to establish new science-based professions for women to "raise-up" Chinese society. First president Mathilda Thurston (MHC B.S. 1896) pushed to develop a strong pre-professional science program including nursing, pre-medical courses and laboratory-based science, as well as teacher preparation. Also important were the support networks of scientific exchanges with the U.S. Ginling became a

sister of Smith College in 1921. Wu Yi-fang, one of its first graduates earned a doctorate in biology at the University of Michigan. In the face of Chinese government demands, she became the first Chinese president of the college and an advocate for women's higher education in China.

Rosemary WALL | University of Hull, United Kingdom

Situating the nurse within British tropical medicine, 1896-1940

British colonial nurses were expected to be highly qualified, many having been trained at prestigious London nursing schools, and they were also expected to be certified midwives. Some nurses decided to study at institutions which would prepare them for colonial service before they submitted their applications. Others were put forward for tropical training courses once they had been selected for colonial work. This paper examines the training which they received, whether at the Liverpool School of Tropical Medicine which specialised in training nurses for work in West Africa, or the London School of Hygiene and Tropical Medicine. At these Schools the nurses were taught by luminaries in the field such as Ronald Ross and Philip Manson-Bahr. Two nurses were sent to East Harlem Nursing and Health Demonstration, New York, County Health Units in Alabama, and universities such as MIT, Yale and Toronto, courtesy of funding from the Rockefeller Foundation. What was appropriate knowledge for these nurses to be taught, what were their experiences of learning in Liverpool, London, the USA and Canada, and what were the successes and limitations in implementing their knowledge in the colonies? In particular, Malaya will be examined, for which a variety of sources exist which document the nurses' work and experiences in a masculine colonial medical environment.

Commentary: Rima D. APPLE | University of Wisconsin-Madison, United States

S089. Beyond the animal model: Linking humans and animals in modern medicine

Wed 24 July, 14:00–17:30 ▪ Uni Place 3.204

Symposium organisers:

Peter KOOLMEES | Universiteit Utrecht, Netherlands

Abigail WOODS | Imperial College London, United Kingdom

Symposium abstract

This symposium aims to explore new ways of thinking about animals within the history of modern medicine. While there is already an extensive literature on the history of using animals to enquire into human health and disease, this suffers from two important weaknesses. Firstly, in focussing on animals in experimental settings, it neglects to consider their use in the non-experimental production of medical knowledge.

Secondly, the epistemological status of the animal is rarely problematised. Authors tend to assume rather than demonstrate that in health and disease, animals served as 'models' of the human body. Yet closer inspection reveals a multiplicity of animal roles: as disease victims, sources of therapy, transmitters of infection, patients, sources of knowledge about the relationships between species, or tools for identifying the universal laws of life and death

The papers presented here will explore a selection of these and other roles played by animals and their diseases in 19th and 20th century medicine. In line with the conference theme, they ask what 'work' animals and their diseases performed. In what ways were expert knowledge, practice, relationships and scientific disciplines constituted around these subjects, and with what implications for the development of modern medical science? Such insights are not simply of

historiographical importance; they also offer important historical context to the present-day movement for 'One Health', which aims to bring human, animal and environmental health closer together.

S089-A

Wed 24 July, 14:00–15:30 ▪ Uni Place 3.204

Chair: Peter KOOLMEES | Universiteit Utrecht, Netherlands

Liz GRAY | Queen Mary, University of London, United Kingdom

William Lauder Lindsay's 'community of disease' of the mind

The study of the transmissibility of cholera between man and the lower animals led to a study in comparative psychopathology during the course of the life of William Lauder Lindsay (1829-1880). The interrelationship of the physical and mental diseases of man with those of the lower animals led to his proposition for the understanding of a 'Community of Disease' of both body and mind. Through this formation of a 'community' Lauder Lindsay attempted to raise awareness amongst both veterinarians and physicians of the connections between their fields of expertise.

The historiography of Comparative Psychology to-date has focused on the development of the objective study of animal behaviours and rejection of the subjective premise that underlay the nineteenth century variants of the discipline. This paper presents a re-exploration of Comparative Psychology, with a focus on the animal-human relationship, providing an alternative conception of the role of animals within the science of the mind of the period. Lauder Lindsay's Comparative Psychology explored the possibility of a shared moral insanity, the subject of his expertise as asylum physician in Perthshire. He used his patients within the asylum to understand the behaviour of animals, just as, if not to a greater extent, animals provided models for the understanding of the diseases of the human mind. The role of the animal within asylum medicine was not limited to the modelling and understanding of the mind - pets and farm animals all feature within the moral treatment regimen of the insane.

Lauder Lindsay's community of disease, as a variant of comparative psychology, provides an important case study through which the many roles animals played within the early manifestations of psychology and the mental sciences can be explored. Through the treatment of animals as subjects, rather than objects of disease, a parallel historiography to that based on the nineteenth-century vivisectioned animal can be presented, expanding the place and role of animals within the scientific practice of this period. Although this paper will focus on the aspects of Lauder Lindsay's work on the science of mind, his 'Community of Disease' gives an indication of the depth of work as yet not fully explored within the history of the 'One Health' movement.

Francis NEARY | University of Cambridge, United Kingdom

Re-evaluating the domestic animal case study: the sources of Charles Darwin's work on animal reasoning

When Charles Darwin (1809–82) was working on both *The descent of man, and selection in relation to sex* (1871) and its 'sequel' *The expression of the emotions in man and animals* (1872), he asked questions of animal breeders, farmers, menagerie owners, friends, family members, zoologists, physicians, writers and clergymen. He received replies, detailing examples of animal intelligence in dogs, cats, horses, parrots and starlings. Many of these found their way into the first editions and, after these were published, he received a plethora of new examples from correspondents both known and unknown to him, often responding on spec to what they had read. Darwin proceeded to use some of these in the subsequent new printings and editions to reinforce his arguments, and to expand the remit of mental and moral faculties attributed to animals.

Through looking at the letters, Darwin's annotations and his manuscript notes, and comparing the published editions, I will investigate the decision-making process of which examples were used and why. In revealing insights into Darwin's working practices and his networks of correspondence, I address the more general question of why these types of domestic animal case study have been dismissed as anecdotal and anthropocentric. I explore whether their status should be re-evaluated in terms of disciplinary contexts of the 1870s, their significance in early studies of animal psychology, and recent scholarship that points away from seeing animals as objects of study and models to think with; and towards companionship, co-evolution, and the multiple ways we live, with animals.

Abigail Woods | Imperial College London, United Kingdom

Animals and their pathologists in Victorian Britain

This paper uses the surviving records of Pathological Societies to develop a new perspective on the place and purpose of animals within 19th century British medicine. Existing literature on this topic tends to privilege the late 19th century experimental sciences of physiology and bacteriology, and to assume that animals were used primarily as models of the human body. Predating these developments, I will reveal the importance of animals to doctors' non-experimental enquiries into disease, and the multiple ways in which their pathology was interpreted.

At a time when pathology barely existed as a distinct, institutionalised profession, the pathological societies played a key role in its development by offering regular opportunities for health professionals to present and discuss specimens. A proportion of these specimens were animals. Drawn from a range of species and derived from multiple sources, their exhibition reveals that in a world with strong traditions of natural history, where doctors lived, worked and played amongst animals, interest in their diseases was viewed as a legitimate pursuit.

From their descriptions of these specimens, I will show that doctors conceptualised animal pathology in several different ways: sometimes it was viewed as identical to human pathology; in other cases, analogies were drawn. Animal disease could also be a source of human infectious disease, or the basis for comparisons across species. Its study not only reveals the proximity of human and animal, but also the development of working relationships between vets and doctors, which throw into question historians' claims of a hostile or non-existent relationship between the professions.

Axel HUNTELMANN | Johannes Gutenberg University, Mainz, Germany

Science in action and livestock in the laboratories

Around 1900 German public health institutions are populated with cattle, pigs, horses, sheep and goats. The Department of Bacteriology and that one of Veterinary Medicine of the Imperial Health Office looked more like a farm house than a laboratory and the Prussian Institute for Experimental Therapy had been enlarged with stable buildings around the turn of the century. In the Imperial Health Office and the Institute for Infectious Diseases life stock and veterinary medicine played an important role in German public health institutions: At the interface between life sciences and agronomy, veterinary knowledge and veterinary medicine was linked to national politics and national economy, agro- and food industry as well as the pharmaceutical industry, public health and risk policy. Linked to national and bio-economy, life stock was seen as valuable national (bio) capital. For these reasons the state engaged in veterinary medicine. In the public health institutions research was done to investigate the character, etiology and transmission paths of epizootics as well as to develop or to improve cures against animal diseases. In the Institute for Experimental Therapy sera and biologicals against animal diseases were controlled on their efficacy and their therapeutic impact.

In the public health institutions cattles, horses and pigs had a different and varying ontological status resulting from their different relations to

humans. Cattles, sheep, pigs and horses had a status as commodities, as patients suffering from mostly fatal diseases like cattle plague, bovine tuberculosis, swine pest or food and mouth disease. (Beyond that, horses were also seen as luxury goods and status symbols as well as working animals). And at the same time life stock was considered – first and foremost – as scientific objects in experimental settings, for instance to investigate the etiology and transmission paths of animal diseases, or to search for remedies against epizootics. Furthermore infected cows and pigs were feared as a public threat because it was unclear if pathogens that cause animal diseases could also infect humans. Especially the discussion about the transmission of bovine and human tuberculosis around 1900 could be cited as an example for this issue. Finally, and due to fact that animals were susceptible to the same pathogens as humans, animals were also a source to produce small pox vaccines or a dispenser to produce serum against animal and human diseases. Serum against erysipelas made pigs happy – according to an advertising of the serum producer.

The paper will trace the different states of life stock in the public health institutes as scientific objects, as a public health threat, as a source for a remedy and as commodities. Moreover, the paper will follow the shifting ontological status and the consequences for the human-animal relationship.

S089-B

Wed 24 July, 16:00–17:30 ▪ Uni Place 3.204

Chair: Abigail Woods | Imperial College London, United Kingdom

Floor HAALBOOM | Utrecht University, Netherlands

Sniffing piglets and coughing horses: animals and the 'influenza-question' in the Netherlands, 1918-1958

In this paper I will analyse the relation between animals and 'the influenza-question' in the Netherlands, from the 'Spanish' influenza pandemic (1918-1919) until the 'Asiatic' influenza pandemic (1957). Like anywhere in the aftermath of the virulent pandemic of 1918, Dutch medical researchers asked questions on the cause of influenza, on the differences in virulence between seasonal epidemics and occasional virulent pandemics, and on the control of the disease. In this research, animal models were of large importance. Animals also suffered 'spontaneously' from influenza, and were observed to do so. My questions concern this zoonotic character of influenza in a sociocultural context: how was it addressed in the framing of influenza? How did different parties encountering people and animals suffering from influenza react to the disease and deal with it? How did these parties relate to one another? I will discuss the conceptual shift in medicine from animal influenza as a curious side-effect of human influenza epidemics in the 1920s, towards the view that animals (especially pigs and horses) were the 'primary influenza virus reservoirs' in the 1950s. During the same period, farmers were struggling with an unknown, often deadly infectious respiratory disease among their piglets, which they called 'piglet disease', 'sniff disease' or 'pig flu'. Vets were reluctant to call this disease swine influenza, like for instance the American animal pathologists R.E. Shope did – Shope was a central figure in international research on the influenza virus. Rather, Dutch vets framed respiratory diseases of piglets as a problem of changing practices in agricultural pig production, which had negative effects on the pigs' resistance against a variety of usually harmless germs. As a consequence, the influenza-question received little attention in veterinary circles, despite calls to the contrary.

This paper is part of a broader PhD project on the history of dealings with zoonoses in the Netherlands during the twentieth century. This project aims to put present concerns on zoonoses in a historical context. The questions I ask are partly based on current scientific knowledge on the zoonotic character of influenza and other zoonoses. Therefore, I will

devote some time to the methodological problem of using current scientific knowledge to investigate the past. I will argue that such knowledge on the influenza virus provides a useful source on the past, when carefully used.

Robert G W KIRK | University of Manchester, United Kingdom

Life before the laboratory: labour and love in the animal house, 1945 onwards

This paper takes up the ICHSTM theme of 'knowledge at work' to examine the forms of knowledge and practice that have sustained the use of nonhuman animals within the biomedical sciences from the mid to late twentieth century. A number of historical studies have addressed the role that experimental animals have played as 'models' in the production of biomedical knowledge. However, the forms of knowledge and practice that sustain animals in their varied scientific roles have yet to be critically examined. The provision of healthy animals for the laboratory required the adaptation and deployment of existing knowledge of animal health and wellbeing, drawn from diverse sites (e.g. the zoo), as well as innovation where knowledge of the needs of a particular species was lacking. This work also required the construction and formalization of new sites, not least the animal house, which have hitherto escaped rigorous historical analysis. This paper charts how the work of maintaining animals for use in the laboratory enrolled existing expertise (e.g. veterinary knowledge) for new purposes, creating new forms of expertise (e.g. the animal technician) and new spaces of work (e.g. the animal house). Giving rise to new networks, these processes cumulatively facilitated exchanges of knowledge across disciplines, geographies, and communities, creating a new auxiliary field of 'laboratory animal science and medicine', was became an essential component of the transnational infrastructure which grew to support the global reach of the biomedical sciences from the mid to late twentieth century.

This paper reconstructs the emergence of specific forms of knowledge and practice that shaped human and animal work in the provision of animals for the laboratory. Questions include how humans and animals interacted in the animal house? How, conceptually and materially, were their interactions governed and to what effect? By exploring these questions the paper will reveal how species identity moved from narratives of national origin to those of welfare need (as animals ceased to be 'from' nature and increasingly became products of and for the laboratory). Driving such transformations was the goal of establishing acceptable standards of laboratory animal care. This agenda gave rise to an expert discourse that transcended the situated needs of a specific research laboratory programmes and their contingent animal models. Rather, 'laboratory animal science and medicine' pursued forms of knowledge and practice that were generic, holding true for all members of a species. Wholly instrumental, and fundamentally material, these processes contributed to the transformation of animal welfare from a moral value grounded in political language to a scientific value embedded in the material cultures of science. A transformation that might can be understood as the materialization of welfare.

Jordan BMM | York University, Canada

Between human and animal astronauts: anthropomorphizing monkeys in early American space medicine

This paper investigates the historical case of Able and Baker, two monkeys that together in May, 1959, became the first non-human primates successfully recovered from a spaceflight. Before and during this experiment, Able and Baker were treated like instruments— anatomical models of human bodies used to generate biological data about the new physical stresses that future astronauts might face. But following the flight, Able and Baker became anthropomorphized in a number of different ways by military doctors, the media, and the general public. Once regarded only as generic models of the amorphous "human

factor" in a risky space experiment, Able and Baker were suddenly cast the image of specific (American) human archetypes for public relations purposes.

This paper explores this transformation in human regard for Able and Baker in a number of medical, scientific, and cultural contexts. Following the experiment, Able (a female rhesus monkey supplied by the Army) was anthropomorphized by medical doctors and science journalists who suddenly took her up as an important human patient. Following her untimely death, Able was again transformed, this time into a male caricature of "the American astronaut" as a taxidermy exhibit at the Smithsonian National Air and Space Museum, and as a character in the 2009 feature film *Night At the Museum: Battle of the Smithsonian*. I also examine how Baker (a female squirrel monkey supplied by the Navy), who survived much longer in captivity than Able, was cast by her human handlers as a domestic American housewife—they dubbed her "Miss Baker", wished she would "settle down and start a family", and even organized a "marriage" to a male monkey "husband".

Using the approach of "animal biography" from animal studies, I attend to the different ways in which each monkey was remade into an unwilling celebrity representative for American space exploration, and how connections to cold war science, technology, medicine, and the military, shifted human regard for the monkeys from non-specific human models, to models of specific humans. I also pay special attention to how Able's controversial death resulted in bitter friction between Army and Navy doctors over best practices. Additionally, this paper brings into focus how these specific acts of animal person-making reveal deep-seated assumptions about human gender roles during the cold war, and more generally, reflects critically on how and why animals used in high-profile, medical experiments often come to be regarded as "more human" afterward.

I suggest that this anthropomorphizing of certain monkeys in American space medicine during the cold war was appealing because it masked the casual violence and lack of choice that these animals were subject to, and because it rendered "natural" the political and military impulses that fuelled early space exploration.

S091. The achievements of R J Boscovich in the philosophy of nature, astronomy, technique and culture: historical resources and contemporary epistemic reflections

Mon 22 July, 11:10–15:40 ▪ Roscoe 2.5

Symposium organisers:

Tomislav PETKOVIĆ | University of Zagreb, Faculty of Electrical Engineering and Computing, Department of Applied Physics, Croatia

Aleksandar PETROVIC | University of Belgrade, Serbia

Magda STAVINSCHI | Astronomical Institute of the Romanian Academy, Romania

Marko URSIC | University of Ljubljana, Slovenia

George VLAHAKIS | Hellenic Open University, Greece

Symposium abstract

Rogerius Joseph Boscovich / Rudjer Josip Bošković (1711, Dubrovnik, Croatia - 1787, Milano, Italy): One of the greatest European scientists of all time, natural philosopher, mathematician, physicist, technician, poet,

Jesuit, diplomat. His research and achievements were spread over the fields of astronomy, optics, mechanics, geodesy, and construction techniques, of his time. Boscovich's epoch-making work "A Theory of Natural Philosophy" (Vienna 1758 and Venice 1763, respectively) with the points-atoms as the ultimate building blocks of Nature, was based on the single universal law of forces that exists in nature. He used a method of thinking of Newton and Leibniz, synthesized and unified them for the first time into his new original method of thinking of Nature. Boscovich's method may be expressed by the epistemological formula of '*more geometrico sive mathematico – more rationali – more empirico – more theologico*', as the four basic concepts of science, philosophy and religion that have been unified together by his mind. Boscovich's contribution reflects many controversial issues of the philosophy of nature and science in particular in the XVIII century. However, his *Theory* itself is fundamental for modern scientific picture and basic concepts of nature till today, due to structure and particles phenomenology included in it. It is crucial to discuss history and actual status of the natural sciences and related technologies along the roads of the Boscovich's legacy.

S091-A. Boscovich's achievements in the philosophy of nature and modern science

Mon 22 July, 11:10–12:40 ▪ Roscoe 2.5

Chairs:

Magda STAVINSCHI | Astronomical Institute of the Romanian Academy, Romania

George VLAHAKIS | Hellenic Open University, Greece

Discussion

Opening discussion on the origins and development of S091, led by Tomislav Petković

Marko URSIC | University of Ljubljana, Slovenia

Boscovich's distinction between the potential and the actual space from the standpoint of modern search for the union of mind and nature, especially in cosmology

Boscovich, in his treatise *De continuate lege* (1754) applied the Aristotelian distinction between *potentia* and *actus* to his conception of space: the "potential" geometrical space is continuous and infinite, while the "actual" physical space is discrete, i.e., it is constituted of "points-atoms" which are bearers of a single force in nature that should be described by the universal natural law(s). In this way Boscovich tried to overcome the traditional opposites between empty space and physical objects, and also the principal philosophical controversy between idealistic and materialistic theories of nature. This distinction between potentiality and actuality was further developed in Boscovich's main work *Theoria Philosophiae Naturalis* (1758) where it served him to upgrade Newton's conception of forces into a unified "dynamic" theory of nature. In my contribution, the main point is that Boscovich's distinction between potential and actual space might be relevant and inspiring in modern search for unification of nature – i.e., not just for the unification of four basic physical forces in the so-called "Final Theory", but for the union of nature and mind, especially from the standpoint of modern cosmology. Next to the treatise *De continuate lege*, my starting point is Boscovich's Appendix to *Theoria Philosophiae Naturalis*, titled "Ad metaphysicam pertinens: De Anima & De Deo" – however, my contribution is not principally historical. My plan is the following: (1) first I shift and generalize Boscovich's distinction between *potentia* and *actus* from the classical geometrical space to the "phase space" of possibilities (we may call it also Hilbert space); (2) theoretical possibilities in the contemporary quantum physics and/or in cosmology can be conceived as different universes in a multiverse, in some "phase space"; (3) now, the principal

question is the following: how the actualization (the "choice") in a huge space of possibilities happens (in cosmology, this is called the problem of "fine tuning"), especially whether mind has some role in this actualization; and finally (4): how Boscovich's conception of the "potential space", which he considers also as the "space of soul" (and/or of mind/spirit) vs. the "actual space" of physical point-particles, could be helpful for solving the modern "mind-body problem", not only in cognitive science, but also in cosmology, i.e., for solving the enigma of the putative "fine tuning" of our universe, which is actually – among and in spite of the huge number of theoretical possibilities for the values of the free physical parameters – "just fit for life". I think that Boscovich's ideas about soul and God in relation to nature might indeed be helpful in this great, perennial philosophical search, as well as in the contemporary scientific research.

Peter LUKAN | University of Ljubljana, Slovenia

Boscovich and the quantum-mechanical combination of dynamical and statistical laws

One of the numerous contributions of Boscovich to science was his development of the unique solution to the problem of best linear fit to a set of astronomical data, nowadays known as linear interpolation. This approach was genuinely statistical and developed roughly at the same time when the normal distribution was being introduced in astronomical measurement practice.

Later on, the use of statistics was spread by Maxwell from practice in astronomy to the theory of atomism, when he established the first statistical laws in physics. Statistical physics became a precursor to quantum mechanics, in which the so called dynamical and statistical laws mingled, at least in Bohm's interpretation. This gave birth to the wavefunction, a concept of temporal development of probability distributions, and also to the specific term quantum measurement.

This meeting of the two types of laws may be interpreted in Boscovich's terms of potential and actual space, which he introduced in *De continuate lege* (1754) and used it to overcome the gap between atomism and plenism by conceiving dimensionless atoms influencing each other via forces. Boscovich adopted the position that we can make calculations only in the potential space, but measure a particle only in one actual position. This potential space can be compared to the phase space of possible actual locations, the concept of potentiality in our description of the atomic world coming from the probabilistic-statistical nature of the wavefunction.

Tomislav PETKOVIĆ | University of Zagreb, Faculty of Electrical Engineering and Computing, Department of Applied Physics, Croatia

Bošković's achievements in natural philosophy in relation to the development of modern particle physics

R. J. Boscovich's achievement in Natural Philosophy for the development of modern particle physics

Tomislav Petković

University of Zagreb, Faculty of Electrical Engineering and Computing (FER), Department of Applied Physics, Croatia

Abstract

R. J. Boscovich (1711-1787) was the first in history of science to combine Newton, Descartes, Spinoza, and Leibniz's method of thought in the middle of the 18th century before the Maxwell-Einstein era of physics, synthesising them into his new method of thought on Nature. His method may be expressed by the epistemological formula *more geometrico sive mathematico – more rationali – more empirico – more theologico*, as the four fundamentals of science, philosophy and religion of his time. Boscovich's *A Theory of Natural Philosophy on points-atoms* as the ultimate building-blocks of matter is based on a single law of forces existing in nature. The *Theory* itself has been fundamental for the

modern scientific picture of the world and the basic concepts of nature to date, due to the structure of nature and the phenomenology of particles it brings. Boscovich is the father of the original pictorial representation of the *atom* (dynamism hypothesis), important both for the modern concept of subatomic particles (from electrons, protons and neutrons to quarks) of the 20th century, and the predicted and expected new *particles* and *objects* of the 21st century.

N. Bohr, W. Heisenberg and L. Lederman did indeed praise the role of Boscovich's *Theory* in physics (science). However, it was Richard P. Feynman who showed keen interest in Boscovich's atomism, having accepted it as his metaphysical credo 200 years later. Using an effective epistemic approach, the author links Boscovich's ingenious *apperception* of *points* and *particles* with Feynman more than two centuries later and his ingenious and precise parton-quark physics of the Standard Model. The scientific-philosophical compatibility of Boscovich's theory with E. Rutherford was put into the limelight by Rutherford's paper from 1911, when he discovered the atomic nucleus and the nuclear model of the atom, by way of three statements: the atomic *nucleus* as Boscovich's *point* – a point source of Coulomb force, an α particle is also a *point*, and the *impact parameter* in an encounter between an α particle and a gold nucleus has the character of distance resembling the one in the Boscovich's curve. The most interesting legacy of the *Boscovich's tree* of repulsion and attraction which lies chiefly in the *tree-level picture of nuclear forces* in contemporary low-energy physics will be shown in presentation.

Boscovich's legacy, based on his epoch-making work *A Theory of Natural Philosophy* (Vienna 1758, and Venice 1763), is particularly important due to the current epistemic challenges of the 'new high-energy physics', as well as for the global interferences between contemporary science and culture.

Tina DOMAZET | University of Zagreb, Faculty of Electrical Engineering and Computing, Croatia

A brief overview of Werner Heisenberg and Ivan Supek's epistemic analyses of the role of Bošković's theory in science

Brief overview on W. Heisenberg's and I. Supek's epistemic analyses of the role of Bošković's theory in science

Tina Domazet & Maja Zokić

University of Zagreb, Faculty of Electrical Engineering and Computing (FER), Croatia

Abstract

R. J. Bošković (1711-1787) is unquestionably one of the greatest European philosophers and scientists of all time. The position that research into Bošković's theory of natural philosophy has neither been closed nor complete has been decisive for the history of science and technology in Croatia. Thus, interpretations of Bošković's thought and work within the framework of the S091 symposium in Manchester in 2013 are very important. We were introduced to Bošković's achievements in physics during lectures on general physics. Having read his *Theory of Natural Philosophy* (1758), it became obvious that we wish to continue researching it until we understand the depth of his insights.

Ivan Supek (1915-2007), a Croatian theoretical physicist, philosopher and historian of science, writer, ethicist and world famous peacemaker, founder and architect of the Ruđer Bošković Institute in Zagreb after WWII, also researched Bošković's work and role in modern science. He gained his PhD in solid state physics in 1940 in Leipzig (mentored by F. Hund & W. Heisenberg), which was the first doctorate in theoretical physics in Croatia and former Yugoslavia. We studied Supek's important philosophical work on Bošković, his *Ruđer Bošković, vizionar u prijelomima filozofije, znanosti i društva* (Zagreb 1989). Supek was particularly fascinated by the fact that Bošković dared to reduce the philosophy of nature as such to a single universal law of forces. He held that Bošković was one of the last geniuses who undertook more work

than man could possibly handle. On the other hand, in *Gesammelte Werke (Physik und Erkenntnis)*, **Werner Heisenberg** (1901-1976) often wrote about and reflected on Greek philosophy and the doctrine of atoms (*Atomlehre*, Leucippus & Democritus), Plato's *Timaeus* and other dialogues, and atomic and modern particle physics. Almost two millennia elapsed before the modern model and theory of atoms was developed, and it is to Bošković, Faraday and Maxwell that we owe the brilliant insight into the space within the atom which is not empty due to a force and/or a field within it. However, Heisenberg does not mention Bošković in his original work, except in the unpublished manuscript of the speech he gave in German at the University of Zagreb in 1969 when he was awarded an honorary doctorate (*Gesammelte Werke, Abteilung C, Band V, Piper, 1989, pp. 427-432*). In it, he refers to Bošković as "a great philosopher and researcher of atoms in atomic theory" or as "a great mathematician, physicist and astronomer", who 250 years ago recognised the first theory of the atom in nature, which has significantly influenced the later development of the natural sciences.

This presentation is based on work co-authored by Maja Zokić.

Discussion

General discussion time to close this session

S091-B. Boscovich's heritage in the European context

Mon 22 July, 14:10–15:40 ▪ Roscoe 2.5

Chairs:

Marko URSIC | University of Ljubljana, Slovenia

Tomislav PETKOVIĆ | University of Zagreb, Faculty of Electrical Engineering and Computing, Department of Applied Physics, Croatia

Magda STAVINSCHI | Astronomical Institute of the Romanian Academy, Romania

Bošković in Romania

Ruđer Josip Bošković was a physicist, astronomer, mathematician, philosopher, diplomat, poet, theologian and Jesuit priest, who lived between 1711 and 1787. He was born in Dubrovnik. He lived most of his life in Italy and France, but he also spent time in other parts of Europe, including the Romanian territories.

In 1756 he began a long career as a diplomat. He spent the winter 1761-62 in Constantinople, the Ottoman capital. He then moved to Poland, after crossing Bulgaria, Dobruja and Moldova.

More information about his journey through the Romanian territories can be found in the *Giornale di un viaggio da Constantinopoli in Polonia* published in 1762. This is a 323-page book that contains a detailed description of the journey, which started on the 24th of May 1762 and finished on the 15th of July of the same year.

On the 23rd of June he arrived at Galați in Moldavia, the largest port town on the Danube River. The unending rain forced travellers to spend a few days there. Boscovich, the astronomer, took advantage to carry out astronomical measurements which are now of greatest importance to Romanians. Indeed, they were the first measurements of which we know for sure the author, the method and the instrument.

After more calculations, he established for Galați a latitude of 45° 23', very close to the correct one, of 46° 40'. In order to determine the longitude, Boscovich measured various distances between Sun and Moon after having set a clock that counted the seconds by means of the Sun's height determined thanks to its reflection on the water.

A few days later, Boscovich left Galați and arrived at Iassy on the 3rd of July. During the journey he met M. De la Roche, secretary to the Prince of Moldavia. Near the palace there was the beautiful lake the astronomer used for determining the coordinates of the location. On the 6th of July he established the latitude of 47° 9'; the centre of Iassy was almost one

minute ahead of the Prince's residence, that is, $47^{\circ} 10'$, which is a very accurate figure. But two observations of the Moon at its passage at the meridian gave him a different result: $47^{\circ} 12'$, which Boscovich considered to be closer to reality, since this time he observed the Moon both directly and through its reflection on the lake.

He used a three-foot telescope designed by the famous English optician John Dollond, with a double objective made of two different types of glass. At its end, he could mount an instrument containing a small, mobile metal mirror, which Boscovich built in London. It helped to project the image of the Sun onto a wall in a camera obscura for the observation of sunspots and eclipses.

This presentation will consider in more detail his rich astronomical calculations and will also give a flavour of his colourful descriptions of the places he visited.

George VLAHAKIS | Hellenic Open University, Greece

He was not there, but his ideas? The virtual presence of Bošković in modern-day science in Greece

Ruder Josip Bošković is considered among the leading figures for the development of physics after the scientific revolution, therefore his life and work are very well studied and a vast relevant bibliography exists. Still there are some open questions regarding his influences in countries or regions where Catholicism was not so strong as for example the part of South-Eastern Europe which was under the Ottoman occupation during the 18th and 19th centuries. The Greek speaking population at that time participated in a procedure to develop its national identity and consequently to deliberate the lands of ancient Greece from the political rule of the Ottomans. A means used for this purpose, was among others, the development of scientific knowledge forming and intellectual movement known as Modern Greek Enlightenment (1750-1821). The Greek scholars who were the leaders in this movement taught contemporary Physics as it was formed mainly by the followers of Newton like Peter van Musschenbroek and Benjamin Martin. Anyhow other prominent European physicists of that time had also a certain influence like Abbe Nollet and Christian Wolff. Having all the above in mind we carried out a research to investigate the direct or indirect presence of Boscovich and his ideas in the works of the Greek scholars. We studied all the public books of Physics and the most important manuscripts published after 1763 the date of the second edition of *Theoria philosophiae naturalis redacta ad unam legem virium in natura existentium* (Theory of Natural philosophy derived to the single Law of forces which exist in Nature), containing his atomic theory and his theory of forces in Venice. In fact, Venice at that time was an intellectual center for Greeks so that it would be very probable that Greeks would have read Boscovich book. On the other hand they would use it openly very reluctantly as most of them were priests of the Orthodox dogma. In our paper we aim to discuss further this situation and to give some examples from the Greek books of Physics which prove that though at a first sight Boscovich was absent from the Greek literature on Physics from 1770 to 1821, if one would examine the texts more thoroughly his ideas, like for example his atomic theory, were present and very well described.

Danko KAMCEVSKI | Independent scholar, Serbia

Boscovich the philologist: the journal of a voyage from Constantinople to Poland

In 1762, Rudjer Boscovich went on a voyage to Constantinople where he was supposed to conduct astronomical observation on behalf of Royal Society from London. However, he did not make it in time, and hence his project failed. But the expedition itself was not wholly fruitless. Ten years later, in 1772, his *Journal of a voyage from Constantinople to Poland* was published in French translation (the Italian original was actually published in 1784, three years before his death). At the time it was practically a best-seller, and rightly so, for it was written in a beautiful style, and contains many observations on culture, history, religion and mentality of the peoples Boscovich encountered during his voyage.

Throughout the journal, Boscovich shines through not only as a historiographer or scientist, but also as a philologist in the true meaning of the word. This "love for words" (which is what philology literally means) is evident in countless names of rivers, hills, mountains, people and their positions within the society – soldiers, servants, priests, peasants – and so forth. Languages such as Latin, Greek, Slavic, and Turkish interact through the name changes. Very often when he lists a toponym of a Turkish village, he is aware of the previous word for it, and is also often aware if the place had already been mentioned in a work of Classical Antiquity. These name changes imply diachronic cultural changes and clashes in the dynamic region between Constantinople and Poland. Cultures and nations come and pass, but words from their languages still remain as monuments to their existence. Boscovich is quite aware of that fact. At the same time, the linguistic diversity is a sign for synchronic cultural and religious diversity that Boscovich reveals in his journal. Hence the thorough analysis of this material shall doubtlessly provide an insight into yet another – philological – aspect of Boscovich the polymath.

Discussion

The symposium will conclude with a general discussion of the papers and themes raised.

S092. Astronomy and its applications in ancient and medieval societies

Sponsoring body:

CHAMA: DHST Commission for the History of Ancient and Medieval Astronomy

Mon 22 July, 11:00–Wed 24 July, 12:30 ▪ Schuster Blackett

Symposium organisers:

ANSARI S M Razaullah | Formerly Aligarh Muslim University, India

Josep CASULLERAS | Universitat de Barcelona, Spain

Alexander JONES | New York University, United States

Symposium abstract

Astronomy in ancient and medieval societies was, in the first instance, practical knowledge. Observation, measurement, modelling, and prediction were employed in and motivated by time-reckoning and calendrics, religion and cult, state and private divination, astrology, and medicine. Applications constrained not only astronomy's practices and theory but also the social status and training of astronomers. Our symposium explores "astronomy at work" across early societies (Mesopotamia, Greco-Roman, West Asia, Medieval Europe, Islam, South and East Asia).

S092-A. Astronomy and its cultural role in the ancient Near East

Mon 22 July, 11:00–12:30 ▪ Schuster Blackett

Chair: Mathieu OSSENDRIJVER | Humboldt-Universität zu Berlin, Germany

Sarah SYMONS | McMaster University, Canada

Stars and death: the role of astronomy in ancient Egyptian funerary culture

Many of our sources for ancient Egyptian astronomical activity come from funerary locations: tombs, coffins, sarcophagi, and mortuary temples. Textual sources often occur in parallel with, or as part of, funerary literature describing the afterlife. These sources include prose or dramatic compositions, diagrams of the night sky, and tables of astronomical data recording or describing star movements. These materials represent the sky in the model universe of the temple or burial, usually decorating the ceiling or underside of a coffin or sarcophagus lid.

This talk examines the role of astronomy in the culture of the afterlife, the function of astronomical texts in tombs, and possible relationships between astronomy among the living and the occurrence of astronomical materials for the use of the dead.

Zoë MISIEWICZ | New York University, United States

What the king, my lord, said: communication between scholar and employer in the Neo-Assyrian court

The letters and reports written by the scholars of the Neo-Assyrian court to their employer, the king, provide a rich body of evidence about the work expected of an astronomer in the seventh century BCE. Through them, we can see what responsibilities these scholars had with respect to the observation, prediction, analysis, and reporting of celestial events. The scholars often refer back to the king's questions as part of their response—"What the king, my lord, said"—which reveals some of the specific demands that the king made of them. Focusing specifically on one of the most important types of celestial event, the eclipse, we will look at exactly what information the Neo-Assyrian scholar was required to convey to his king, what additional details the king sought out, and what this reveals about the overall work requirements of this ancient astronomer. We will see that his responsibilities extended beyond simply the prediction and observation of celestial events; he was also required to interpret these events as omens, and to advise the king on what apotropaic rituals should be carried out to protect against negative outcomes. Looking at the combination of elements that made up the job of the celestial scholar, as revealed in his communication to the king, we will gain insight both into the working life of the scholar and into the perception of the eclipse in the Neo-Assyrian world.

John STEELE | Brown University, United States

The use of astronomy in Mesopotamian medicine: theory and practice

This paper will explore the role of astronomy in ancient Mesopotamian medicine. In particular I will discuss a group of texts from the last four centuries BC which relate days in the year, signs of the zodiac, and the ingredients used in preparing medical remedies. Several of these texts rely upon numerical schemes based upon a simple model for the motion of the moon. In this paper I will focus on two questions: (i) the relationship between the mathematical schemes found in these texts and other lunar models in Babylonian astronomy, and (ii) whether these texts were purely theoretical explorations or were used in actual medical practice.

Teije DE JONG | University of Amsterdam, Netherlands

The evolution of the Saros and the early development of Babylonian lunar theory

The development of Babylonian lunar and planetary theory is based on the observation of periods, of variations in these periods as a function of position in the lunar or planetary orbit, and on casting these variations in strictly periodic arithmetic difference schemes by clever numerical manipulation.

In this paper I will limit myself to Babylonian lunar theory and - more specifically - to an investigation into the observational basis of the parameters used in the computation of the longitude of the Sun and the orbital velocity of the Moon (functions B and F in lunar ephemerides of system A and functions A and F of system B). Since function Φ of

system A, whose exact interpretation is still enigmatic, has the same period as function F the results may also be relevant for a better understanding of function Φ .

The time frame for the early development of lunar theory is constrained by a few early texts. These texts show that functions F and Φ were fully developed by the middle of the 5th century while the other functions were still under construction or experimented with. The earliest known fully developed lunar ephemeris (system A) dates from 319 BC.

I will argue that the observational basis for the early Babylonian lunar and solar theories is formed by the observed periodicity in the heliacal rising of the star KAK-BAN (Sirius) of 334 synodic months (27 years) and by the observed periodicity in lunar eclipses (Saros) of 223 synodic months (about 18 years). In the course of time the Babylonian scholars became aware that these periods are not exact. I will show that by clever arithmetical manipulation of these two periods and their errors, the Babylonian scholars could have constructed the period relations on which the solar and lunar theories are based. The magnitude of the errors in the observed periods was estimated from the slow drift of the date of the Sirius risings in the lunar calendar and in the gradual evolution of the "Early Saros Scheme" by which the upper lines in the groupings of 7 or 8 consecutive lines in the scheme become depopulated and the lower lines become activated in the course of a few hundred years. Functions F and Φ of system A are the oldest elements of lunar theory and were probably developed late in the 6th century BC.

S092-B. Instruments and inscriptions in Greco-Roman astronomy

Mon 22 July, 14:00–15:30 ▪ Schuster Blackett

Chair: Alexander JONES | New York University, United States

Jérôme BONNIN | HALMA-IPEL, UMR 8164, France

Timekeeping in Greco-Roman antiquity: a social necessity?

The purpose of the present paper is to provide comprehension guidelines of some specific fields of activity covered by the horologia. Greco-Roman clocks form a vast archaeological corpus still under-exploited and for the most part unpublished. However, the subject deserves great attention since the fields of activities covered by those instruments are numerous. Especially in Roman time, they were everywhere, in cities' public places, inside the domus of the wealthy, but also in the garden of villae, by the side of necropolis, on some graves. Some were designed for professional or geographical uses (for example in order to be used during long travels, as early compasses). Inside sanctuaries, their uses are not totally understood but they undoubtedly took an active part in the definition of the cult. Some were monumentalised and, as such, were ordered and offered by citizens. In front of such documentation, many questions arise. Timekeeping is obviously linked with astronomy and early Greek astronomers' researches. Sundials can thus be regarded as a material expression of a conceptual comprehension of the world. They reflect a sort of perception of the Cosmos and, as such, were frequently used as learning tools. But in most cases, Greco-Roman "Horologia" were much more than mere "time keepers". From the third century B.C to the fifth century A.D at least, clocks were displayed everywhere. But progressively, the quality of those instruments decreased. Obviously, they were not any more created to meet scientific requirements but social ones. To possess a timekeeper became a sign of wealth (be it material or intellectual), a sign of domination. To offer a clock became a common act of euergetism in the cities of the Empire. Hours and clocks ruled the everyday life of most citizens of the Roman Empire. Clocks impacted even mentalities since they became a frequent symbol in sarcophagi, gems or mosaics, in order to represent time, seasons or fate. Therefore, they deserve our attention

as astronomical tools but also as sociological objects: studying Greco-Roman clocks can help us understand our modern conception of time.

Daryn LEHOUX | Queen's University, Canada

Reflectance transformation imaging and astronomical inscriptions

This paper presents the results of recent imaging work on two astronomical inscriptions from Berlin's Antikensammlung and the British Museum: a parapigma from Miletus and a late antique portable sundial. It briefly introduces the inexpensive and powerful process of Reflectance Transformation Imaging (RTI), and illustrates the effectiveness of this relatively simple photographic method for epigraphic analysis. Using RTI, the authors were able to tease out otherwise illegible characters. The technique was particularly successful in the case of the sundial, increasing the legible number of place names by nearly twenty percent over the previous edition, and also improving on many latitude readings for the regions for which the dial was theoretically usable.

This presentation is based on work co-authored by George Bevan.

John D. MORGAN | University of Delaware, United States

The lunisolar calendar on the Antikythera mechanism

The recent application of microfocus X-ray computed tomography to the upper back spiral of the Antikythera Mechanism has revealed that there was inscribed on it a Metonic cycle of 19 solar years = 235 lunar months named Phoinikaioi, Kraneioi, Lanotropioi, Machaneus, Dodekateus, Eukleioi, Artemisioi, Psydreus, Gameilios, Agrianioi, Panamos and Apellaios (Freeth, Jones, Steele, and Bitsakis, *Nature* 454 (2008), 614-617, with extensive Supplementary Notes). After a brief introduction to Greek lunisolar calendars, we present confirmatory evidence that this calendar was that of Corinth, or one of Corinth's colonies in NW Greece, or a member of the Epirote League, which may have adopted this calendar from one of Corinth's colonies in Epirus, possibly from Ambrakia in the time of Pyrrhos. In particular, we will demonstrate the invalidity of the reasons recently given by P. Cabanes, *Tekmeria* 10, 2010, pp. 249-260, for supposing that the calendar of the Mechanism and that of Epirus were different. After eliminating previously misread epigraphic evidence that there was a month called Haliotropios ("solstitial") in the calendars of Epidamnos and Epirus, we present direct and indirect evidence from Syracuse, Issa, the Peloponnesos and Rhodes that the pan-Dorian month Karneioi = Kraneioi generally fell around the time of the autumnal equinox, and hence that Phoinikaioi fell in the early autumn and Lanotropioi in the late autumn, rather than around the winter solstice. We also demonstrate that the calendar of the Mechanism cannot have been the calendar of Syracuse (an ancient Corinthian colony which was the home of Archimedes, who is known to have built orreries), since the Syracusan calendar had in place of Machaneus and Agrianioi months called Apollonioi and Damatrios, respectively.

This presentation is based on work co-authored by Paul A. Iversen.

James EVANS | University of Puget Sound, United States

Approaches for the epoch of the Antikythera mechanism

Derek de Solla Price conjectured that the Antikythera Mechanism was engraved circa 87 B.C. More recently, Tony Freeth, Haralambos Kritzas, Mike Edmunds and their collaborators, using the forms of the Greek letters in the inscriptions, proposed that the mechanism was constructed around 150–100 B.C. But scholarly opinion remains unsettled on this issue. In this paper, we offer several approaches to determining the epoch, or intended starting date, of the Antikythera mechanism. The epoch is the "year 1" from which the ancient mechanic reckoned time for the purpose of the mechanism's display. (The epoch is not necessarily the same as the date of manufacture, though it would be surprising if they were very widely separated in time.) As is well known, the first

eclipse on the Saros dial was probably located at month 2, while the most natural position would be the first month. Also it is also easy to show that this is not the first eclipse of any 8- or 7-eclipse group. Both considerations suggest that the Saros cycle was intended to be coordinated with the Metonic cycle, in such a way that both cycles have the same starting date. If this is correct, then it would be possible in principle to calculate this date if there were sufficient other evidence to restrict the possible candidates. We will show that it is possible to introduce new constraints in order to greatly restrict the possible solutions. These constraints involve a) the discovery of new solutions (in addition to those that have been published) fitting the extant eclipse glyphs and consistent with the Babylonian Saros eclipse rules; b) a fruitful new interpretation of the omitted solar eclipses on the Saros dial; and c) physical evidence in Fragment A that can be used to infer simultaneously applicable values for several angles of the lunar theory. These angles need not be chronologically meaningful in themselves, but they may offer the possibility of "winding back" the least disturbed parts of the mechanism to a configuration consistent with the starting date. When all these approaches are used in conjunction, it is possible to offer a surprisingly small number of candidates for epoch.

This presentation is based on work co-authored by Christian Carman.

S092-C. European medieval astronomy and astrology

Mon 22 July, 16:00–17:30 ▪ Schuster Blackett

Chair: David JUSTE | Bayerische Akademie der Wissenschaften, Germany

Alena HADRAVOVA | Centre for the History of Science, Czech Academy of Sciences, Czech Republic

The iconography of Ratdolt's woodcuts in his edition of Hyginus's *Astronomy*

Hyginus's work *On astronomy* deals especially with a mythological origin of constellations and their mutual positions on the sky. It is based on Eratosthenes's *Katasterismoi* and Aratos's *Fainomena* (depending on Eudoxos's not preserved work and on other writings). In Middle Ages, Aratos's, (Pseudo-)Eratosthenes's and Hyginus's works were copied both in their „original“ form, and in the form of *scholia* and commentaries, which became a base for Michael Scotus's treatise *De signis* (c. 1220), the edition of which was published by Silke Ackermann in 2009.

The contribution deals with the iconography of the Ratdolt's collection of woodcuts published in his first edition of Hyginus's *Astronomy* (1482) and several times later (1485, Thomas de Blavis 1488, Ratdolt 1491 etc.). It is concluded, that the Ratdolt's woodcuts are strongly influenced by Michael's text and by medieval tradition of his predecessors. These woodcuts are not thus entirely appropriate to illustrate Hyginus's text; many of them are obscure without knowledge of Michael's text.

Petr HADRAVA | Astronomical Institute of the Czech Academy of Sciences, Czech Republic

Construction and use of Ptolemaic armillary astrolabe and precession celestial globe

Ecliptical coordinates of fixed stars observed using armillary astrolabe were compiled in Ptolemy's *Almagest*. This Star catalogue was the source of the coordinates for construction of various instruments until the end of the Middle Ages. The original but rarely used purpose of this catalogue explained in the *Almagest* was the construction of a universal precession celestial globe which enables to model rises and sets of the stars and degrees of zodiac at any geographic latitude and historical epoch. A unique preserved example of such a universal globe is the 13th century Premyslid celestial globe saved now in Bernkastel-Kues. A detailed comparison of its construction with the description in *Almagest*

reveals a direct influence of the ancient Greek astronomical tradition.

Teri GEE | Brigham Young University, Idaho, United States

‘Not compelled but strongly influenced’: Roger Bacon’s defense of astrology in his *Opus maius*

In thirteenth-century Europe, astrology was a much-studied and often-condemned subject. Its place as one of the sciences was contingent upon the particular milieu in which it was practiced. For Roger Bacon, a Franciscan friar in Paris, it was not only an important subject but vital to the preservation of Christianity. However, astrology was often merged with black magic and other heretical practices, making a defense of it necessary. In his *Opus maius*, Bacon attempts to explain that astrology is not only safe to practice but is important because, without knowing the influences which come from the stars, a man is condemned to be controlled by them. This assertion illustrates Bacon’s views on man’s free will and how much power the stars exert on the sublunar realm. The issues of determinism and man’s free will are present in many other defenses of astrology, both contemporary with and prior to Bacon’s *Opus maius*. Bacon’s solution to preserving man’s free will while still ascribing power to the stars is one that bears interesting similarities to that of Abu Ma’shar in Book I of his *Kitab al-Madkhal al-kabir*. Both men attempt to avoid the strict determinism that would have the stars controlling all aspects of a man’s life, removing his free will, while maintaining the tradition of particular stellar influence which had been a part of astrology at least since Ptolemy’s *Tetrabiblos* in the second century A.D. However, each solution, while achieving much the same goal, follows a different path which especially reveals the religious overtones of Bacon’s defense and his desire to give power to Christianity through the use and understanding of astrology.

Stephan HEILEN | University of Osnabrück, Germany

Presentation of astronomical data in early modern conjunctionist astrology

This paper will be based on printed Latin texts from the late 15th and early 16th centuries that are based on the Arabic doctrine of the Great Conjunctions. This astrological theory was devised to predict the fortunes of religions and dynasties as well as other kinds of historical events, based primarily on the conjunctions of Saturn and Jupiter. Interestingly, many of these texts never provide the reader with systematic information on the entire set of astronomical data on which the predictions are based. For example, Paul of Middelburg, one of the foremost astronomers of the 15th century and successor of Regiomontanus at Padua, wrote an astrological prediction for the conjunction of Saturn and Jupiter in 1484 which runs, in the editio princeps, to 43 pages. The reader can only reconstruct the planetary alignment of the conjunction by collecting pieces of information that are scattered over the entire text. Another author, John of Lübeck (1474), active in the same university of Padua, applies a different method: He writes a prediction for the conjunction of 1504 in which he sets out providing systematic data regarding longitudes, latitudes and other parameters regarding the planetary alignment of the conjunction. My paper will investigate the ways how the authors of such texts generate, select and present the astronomical data. It will further try to provide explanations for the different strategies followed by the respective scientists.

S092-D. Astronomy and its applications in western Asia and the Islamic world

Tue 23 July, 09:00–10:30 ▪ Schuster Blackett

Chair: Benno VAN DALEN | Bavarian Academy of Sciences and Humanities, Germany

Jefferson SAUTER | Independent Scholar, United States

Innovative astronomy in medieval Georgian religious and secular works

Medieval written sources from Georgia provide an enlightening case study in understanding how astronomy was adapted in religious and secular works for a society on the periphery of the Byzantine and Islamic worlds. Religious calendrical works and biblical prognostication texts are among the numerous astronomical written sources preserved in medieval Georgian manuscripts. For the most part, these Georgian sources are based on Byzantine models. On the other hand, Persian and Byzantine influences, including astronomical ideas and beliefs, pervade medieval Georgian literature, particularly poetry. A medieval Georgian calendrical work, prognostication text, hagiography, and epic poem show how long-held astronomical ideas and beliefs were tailored, with subtle innovation, for a specifically Georgian audience.

This presentation is based on work co-authored by Wayne Orchiston.

Yoichi ISAHAYA | The University of Tokyo, Japan

A Chinese calendar in Persian: the missing link in Chinese astronomy

In the thirteenth century, the Mongols established a large contiguous land empire across Eurasia, where cross-cultural contact flourished at an unprecedented scale. For example, a Chinese calendar (lunisolar calendar) was first described in a *zīj* (astronomical handbook with tables) in this period.

In this paper, I shall deal with a chapter concerning a Chinese calendar in the *Zīj-i Īlkhānī* by Naṣīr al-Dīn Ṭūsī (1201–1274). So far, in academia, this calendar has been called the ‘Chinese-Uyghur’ calendar, but I shall argue that this title is not necessarily accurate and that the Uyghurs, who had political and cultural importance in the nascent period of the Mongol empire, were not involved in compiling this calendar. Rather, this calendar was directly brought from China proper by a Chinese Taoist master who accompanied his Mongol ruler.

This Chinese calendar, written in Persian, gives us a unique firsthand view into a civil Chinese calendar. We can find few sources on this topic in China now. Furthermore, this civil-form calendar has several elements in common with the *Shou shi li* (授時曆), the official calendar of the Yuan dynasty (1271–1368), distributed from 1281 sometime after the compilation of the *Zīj-i Īlkhānī*. By looking at the flow of astronomical knowledge from the civil calendar to the official one through research on the Chinese calendar in the *Zīj-i Īlkhānī*, we perceive a ‘productive’ relationship between the official and civil spheres in the astronomical field in China. This is despite the fact that some scholars have argued that activities relative to astronomy, and calendar making in particular, were restricted to the official realm in Chinese dynasties. A thousand miles away from China, in Iran, the *Zīj-i Īlkhānī* preserves the form of a civil calendar that has been lost in China itself.

Johannes THOMANN | University of Zurich, Switzerland

An Arabic ephemeris for the year 954/955 CE in the Strasbourg papyrus collection

The Strasbourg papyrus collection forms a part of the Bibliothèque Nationale et Universitaire (Strasbourg) and is one of the prominent collections of its kind. It hosts 5200 documents on papyrus. In a survey of Arabic documents on astronomy in the collection, I found a papyrus horoscope and could date it to the year 896 CE (edited by J. Thomann, in: *Actes du 26e Congrès international de papyrologie*, Genève 2012, pp. 747–750). Another document, a fragment of an early Almanach, probably from the 10th century CE will be published in the future. In the present paper, an unpublished fragment of an ephemeris will be analysed. It contains parts of the chronological section, and the positions of the sun and the moon on the recto. The days of the months in the Persian, Syriac, Coptic and Arabic calendars are presented together with the day of the week. These data allow for a sure

identification of the year of the ephemeris, namely the Persian Year 323 (954/955 CE). On the verso, positions of Venus, Mercury and the lunar node for the following month are preserved, together with the height of the sun at noon and the length of the day. Obviously, the original layout was different from the layout of other early Arabic ephemerides, which displayed the data of a month on a bifolium. In the present document, the data of a month were displayed on a single page. On the right margin of the recto, names of months and feasts are to be found. On the left margin of the verso, retrogradation and standstill of planets are indicated. The positions of the sun are more than five degrees less than the precise values and indicate that outdated astronomical tables were used for calculation. A similar case with a comparable deviation of solar positions is an ephemeris for the year 931/932 CE in the Vienna Papyrus Collection (forthcoming publication by J. Thomann in: From Nubia to Syria: Documents from the Medieval Muslim World, Leiden 2013). As it seems, more advanced astronomical tables, produced in the East, were not available in Egypt before the time of the Fatimids.

Pouyan REZVANI | Institute for the History of Science, Iran

The role of *ʿilm al-mīqāt* in the development of sundials in Islamic civilization

Timekeeping (*ʿilm al-mīqāt*) was one of the applied astronomical disciplines from the Islamic period in which one deals with determination of the Muslim's prayer times using the shadow of sundial gnomons. According to the Islamic religious sources, such as *ḥadīth* and legal elaborations, *zūhr* and *ʿaṣr* praying times should be determined based on the shadow length of gnomon. Indeed the sundial has historically been used as an astronomical instrument by which determining the time based on the shadow length of gnomon is possible; as a matter of fact, in Islamic societies (particularly in Syria and Egypt) some institutions were formed in mosques which were dedicated to such activities officially and they used reckoning methods for this purpose. At the same time, the methods for making sundials were developed as well. Some Muwaqqits, (people who were expert in *ʿilm al-mīqāt* and worked for mosques), compiled major works which played important role in this evolution. It is noteworthy that these activities promoted some fields such as mathematical astronomy, particularly spherical trigonometry. Because of the importance of *ʿilm al-mīqāt*, it prevailed in Islamic territories very soon. This research provides a survey of the formation and development of timekeeping methods from the Islamic period (between 11th and 16th c. CE) and their roles in the development of sundial designs and constructions. It also comprises various traditions of timekeeping, the most important astronomers who contributed to this field, and their works. The transmission of timekeeping methods in Egypt, Syria, Yemen and Turkey is also discussed.
Keywords: Timekeeping, *ʿilm al-mīqāt*, Prayer Time, Sundial, Gnomon, Muwaqqit.

S092-E. South and East Asian astronomy, part 1

Tue 23 July, 11:00–12:30 ▪ Schuster Blackett

Chair: ANSARI S M Razaulah | Formerly Aligarh Muslim University, India

Michio YANO | Kyoto Sangyo University, Japan

Sho HIROSE | Kyoto University, Japan

Mathematical models and cosmology in early Indian astronomy

It is widely accepted that Indian mathematical astronomy changed drastically under the influence of Greek astronomy around the 3rd century CE. One of the points to be noted is that although Greek elements are evident in Sanskrit texts on astronomy, they all belong to the time before Ptolemy and nothing is found of the innovations initiated by him: for instance, the second anomaly of the moon, the 'equant' of the

planetary model, and spherical trigonometry. Thus there were attempts to search for the origin of geometrical models of Indian astronomy in the Hellenistic astronomy before Ptolemy. But a paucity of documents has prevented satisfactory explanation of the link between the Mediterranean area and India. The first Sanskrit text that deals with planetary theory using geometrical models is the *Āryabhaṭīya* of *Āryabhaṭa* (born 476 CE). We regard this text as the endpoint of the long process of Sanskritizing Greek astronomy. The planetary theory is found in the last eight verses of Chapter 3 (*Kālakriyāpāda*), where the basic units of time and the elements of calendar are described. In India the position of planets was a topic of calendar to be used for casting horoscopes. The text of the *Āryabhaṭīya* is expressed in very condensed verses and difficult to understand without the help of commentaries. The eight verses under discussion are also expressed in very terse wording and allow different kinds of interpretation. We took resort to the oldest surviving commentary by *Bhāskara I* written in 629 CE, although we are not very sure whether he conveyed the true meaning of *Āryabhaṭa*. It seems that he wanted to convince the reader by claiming that he was the true follower of *Āryabhaṭa*'s school. However, commenting on *Āryabhaṭa*'s planetary theory, *Bhāskara* refers to the opinion of 'others', showing that already in his time there were different interpretations. In the Indian planetary theory two epicycles play an essential role. They are called *manda-vṛtta* and *śighra-vṛtta* and were used to explain eccentricity and anomalistic motion, respectively. It was also known that a *manda* epicycle produces the same result as an eccentric circle (*pratimaṇḍala*). According to *Bhāskara*, these models are only *upāyas* (artificial means) by which to express reality. Upon this a question arises: how was the reality conceived and where were the true planets thought to be located? Another point of discussion is whether Indian astronomers could totally dismiss traditional cosmology.

B S SHYLAJA | Jawaharlal Nehru Planetarium, India

Stone inscriptions as sources of astronomical records

India has a rich heritage of inscriptions available at almost every village with dates ranging from 2nd century BC to the 19th century AD. We have studied about 40000 inscriptions distributed in South India and searched for astronomical records. It has been possible to identify solar and lunar eclipses very distinctly mentioned and verifiable from modern calculations. Some interesting cases show the geographical limit of the visibility of eclipses. The records of winter and summer solstices are abundant. A smaller number of records indicating planetary conjunctions also have been traced. This study throws light on a hitherto unknown parameter called *vyatipatha*, which can be defined as the event when the magnitudes of the declinations of the sun and moon are equal. Many Sanskrit texts describe the event in great detail but the actual need for observation remained unnoticed. A detailed study of the *vyatipatha* records give a hint on the possible observational technique which was used for predicting eclipses. The sudden absence of this term in inscriptions later than 18th century possibly hints on the success of a mathematical formula.

Kim PLOFKER | Union College, United States

Balancing calculation and observation in medieval Indian astronomy

Nearly three hundred years after historians of science began analyzing the works of astronomers in medieval India, it remains quite unclear how those astronomers actually looked at celestial objects in the sky, and how (or whether) they used what they saw there to create and modify their quantitative theoretical models. The long shadow cast by Ptolemaic astronomy has blurred the details of a wide variety of ancient and medieval scientific practices. It is frequently taken for granted by historians that the basic theory-building process that Ptolemy described (which may not have been identical to the one he followed) was or should have been the default approach for all serious astronomers: hypothesize a self-consistent geometric model for celestial motions and

then establish its parameters from observational data. But it is still far from certain whether and to what extent medieval Indian astronomy fits into this methodological mold. This talk examines the existing textual sources and proposed reconstructions of Indian astronomers' scientific methods, and identifies some crucial sources of controversy.

Ramasubramanian K. | Indian Institute of Technology Bombay, India

The implication of *Asakrt-karma* on planetary orbit

The Indian astronomers have been employing a certain mathematical technique called *asakrt-karma* in order to deal with the problem of interdependence among the variables involved in planetary computations. This technique is essentially an iterative procedure that may also be conceived as the method of successive approximation that converges to a limiting value. The term *asakrt-karma*—literally meaning 'doing more than once'—is also called *avisesa-karma* in the sense that this iterative process is to be carried out till we get consecutive values that are very close to each other. That is, the successive values do not differ from each other (*avisesa*), upto a specified degree of accuracy. Among the astronomical works that are extant today, the earliest one that provides a systematic exposition of the method of *asakrt-karma*, is *Maha-bhaskariya* of Bhaskara (c.~7th century). During the talk we will provide a clear exposition of this procedure as described by Bhaskara in the context of computing the *manda-sphuta-graha* (the longitude of the planet corrected for the eccentricity of its orbit) and also study the convergence of the iterative process. We will also discuss the physical significance of doing *asakrt-karma* in terms of the geometry of the planetary orbit.

S092-F. South and East Asian astronomy, part 2

Tue 23 July, 14:00–15:30 ▪ Schuster Blackett

Chair: John STEELE | Brown University, United States

ANSARI S M Razauallah | Formerly Aligarh Muslim University, India

The astronomical writings of the descendants of Ahmad Ma'mâr, architect of the Taj Mahal

It is well known that Ahmad Ma'mâr Lâhorî (d. 1649) was the architect of Taj Mahal, the mausoleum of the Queen of Mughal Emperor Shahjahan (reigned 1628-1658). However, he was interested also in the exact science of his times, which is evident from the training of his sons : Atâ'ullâh as a mathematician, and his second son Lutfullâh (d.1681), who was also a mathematician and a poet with nom de plume Muhandis (the architect). Lutfullâh was initiated in astronomy by his father, when he asked him to translate into Persian, "Book on the Constellations of Fixed Stars" by 'Abd al-Rahmân al-Sûfî (903-998). Lutfullâh has to his credit 9 scientific works and a couple of literary works also. Out of these, 4 writings are concerned with astronomy: on calendar, direction of Mecca, commentary on the "Exposition of Astronomy" by al-'Âmilî (d. 1692), and which was used extensively in Muslim colleges (madrasas) in India.

Imâmuddîn (d. 1732), the eldest son of Lutfullâh, was a mathematician, astronomer, a prolific writer, also a poet with nom de plume : Riyâdî (the mathematician). He is known for his Anthology of poets, sûfis, scholars etc. Out of his 9 scientific writings, 5 concern with astronomical topics. However, he wrote mainly commentaries on astronomical classics in Arabic.

Mirzâ Khayrullâh Khân (d.1748), with the poetic name Muhandis, was the second son of Lutfullâh. He was the director of Raja Sawâ'i Jai Singh's observatory at Delhi, in which capacity he compiled the *Zij-i Muḥammad Shâhî* (ZMS). He has to his credit 6 astronomical writings

out of 10 scientific works. His major work was ZMS, of which he was the actual author and also of its commentary. Another important work is his Persian translation with commentary of al-Tûsî's Recension of Ptolemy's *Almagest*, *Taqrîb al-Tahrîr*.

Muhammad 'Alî Riyâdî, son of Khayrullâh, was also a known mathematician and also a calligrapher (*Khushnawîs*). He prepared a fair copy of his father's *Taqrîb al-Tahrîr*. According to my survey, he has to his credits 7 tracts concerning astronomy, namely, on calendar and planetary calculations, and astrolabe.

I wish to present my survey of these astronomical writings of Ahmad Ma'mâr's descendants, emphasizing their significance for the history of astronomy in Medieval India.

Sriram MYYASANDRA SUBRAHMANYA | University of Madras, India

Use of continued fractions in *Karanapaddhati* (c.1730 CE), a Kerala astronomy text

The south-western province of Kerala in India is known for its important contributions to mathematical analysis and astronomy in the medieval period. What is termed the 'Kerala school of astronomy and mathematics' emerged during 14th–18th centuries. *Karanapaddhati* of Putumana Somayaji composed around 1730 CE is one of the important texts of this school. In the Indian astronomical tradition, the '*Karana*' class of texts choose a recent epoch and outline only the computational procedures for planetary positions, diurnal quantities, eclipses etc., with the aid of arithmetical / algebraic expressions without presenting any theoretical framework. *Karanapaddhati* is a unique treatise in the Indian tradition of astronomy which aims at assisting astronomers in preparing *karana* texts, by giving the *paddhati* (method) for the algorithms.

The computation of the longitudes of the Moon and the planets involve the rates of motion of their mean longitudes and the zodiacal and solar anomalies (*mandakendras* and *sighrakendras*). Accurate computations would involve ratios with large numerators or multipliers (*gunakaras*) and large denominators or divisors (*harakas*). *Karanapaddhati* expresses these ratios as continued fractions. The approximations to the exact ratios involve small multipliers and divisors. These small multipliers and divisors play a crucial role in the algorithms for generating the mnemonics or *vakyas* for the true longitudes of the Moon and the planets. There are relations among the multipliers and divisors arising out of the continued fraction method. Putumana Somayaji is ingenious in using them to formulate the algorithms.

GUAN Yuzhen | Brown University, United States

Eclipse prediction in early China from the Eastern Zhou Dynasty to the adoption of the Jing chu li in AD 237

This study aims to investigate the methods of solar and lunar eclipse prediction in China before the 4th century AD, with a detailed example of the eclipse theory in the *Jing chu li* (Luminous Inception System 景初曆). As the official calendar of the Jin dynasty and the Kingdom Wei during the Three Kingdoms period, the *Jing chu li* was used for more than 200 years after it was adopted in AD 237. Eclipse theory is important in Chinese calendrical systems not only because it reflects the mathematical astronomy at the time, but also for the significance of eclipses within Chinese judicial astrology. For example, solar eclipses were recognized as one of the most ominous astronomical phenomena. This paper will address two questions: first, when did Chinese astronomers start to predict solar and lunar eclipses? Second, how did ancient Chinese astronomers improve eclipse prediction methods from the *San tong li* (Triple Concordance System 三統曆) of the Western Han to the *Jing chu li*. Over this period, methods for predicting eclipses developed in three important ways: (i) from predicting only lunar eclipses to the prediction of both solar and lunar eclipses; (ii) from relying only on the mean periods of the sun and the moon to taking into consideration

the variation in lunar velocity; (iii) from estimating only a rough date to predicting the eclipse's magnitude and the direction of the eclipse shadow. In addition to a detailed analysis of the various calendrical systems, further evidence will be drawn from other texts including historical writings.

Niu Weixing | Shanghai Jiao Tong University, China

Planetary ephemeris between the late Tang and early Song period (AD 800-1000): a technical manual for fortune-tellers

It is expounded firstly in this paper that a kind of foreign originated planetary fortune-telling system was accepted and applied widely between late Tang Dynasty and early Song Dynasty in China. It is also explained that the calculating of the planetary ephemeris, which was an important handbook for fortune tellers, then became a necessary technical support by astronomy for astrology. It is pointed out finally that this kind of support could be provided by some astronomers or astrologers proficient in the astronomical calculation, and the calculation of the positions of celestial bodies obtained a quite high precision, according to a detailed investigating to a number of specific fortune-telling cases between late Tang and early Song period.

S092-G. South and East Asian astronomy, part 3

Tue 23 July, 16:00–17:30 • Schuster Blackett

Chair: Michio YANO | Kyoto Sangyo University, Japan

Raymond MERCIER | University of Cambridge, United Kingdom

A survey of mean longitudes in Chinese astronomical systems

The Chinese calendar was subject to revision at regular intervals, from the Han period until that of the Ming. More than one hundred different systems are named, although not all of these are documented in full detail in the available sources. Although referred to conveniently as a 'calendar' each system is a full specification of the Sun, Moon and planets, including as a rule the lunar node and apogee. Each system therefore includes nine mean longitudes, as well as the equations of the Sun, etc. In this survey, which is confined to the mean longitudes, 35 different systems are analysed, taken from sources ranging from the Han to the Ming dynasties. The aim is to display the comparison between the nine mean longitudes in each system against modern calculations. These displays will allow one to see the striking differences between the Chinese achievement and that of Greek-Indian-Arabic practice.

Xu Fengxian | Institute for the History of Natural Sciences, Chinese Academy of Sciences, China

Square or orientable?

It is believed that the idea of "a round heaven and a square earth" had played as a domain cosmology in ancient China. The earliest record of this idea appeared in a text compiled in the first century AD, which recorded a dialogue between two thinkers of the fifth century BC doubting this idea. After that though often under critics, this idea appeared in more and more literatures. Modern historians of Chinese astronomy all believe it to have had existed, too. The present article set forth that the idea of "a square earth" had never existed in ancient China. In Chinese, the word *fang*, which is interpreted as "square" in this context, has another meaning as "direction, orientation, or locality", etc. Since in the 13th century BC oracle bone inscriptions the word *fang* has the later meaning only, the original meaning of *fang* had no meaning of "a square". Archaeological discoveries show that from the mid Neolithic period (c.a. 3500 BC) on, almost all important cultures of Chinese civilization began to pay great attention to directions. Buildings such as

altars, city walls, palaces, began to orient to the four cardinal directions intentionally. In the late Neolithic Taosi Site a ritual observatory was found which had been designed carefully for observing the sun's rising from different directions at different seasons. Establishment of the four cardinal directions as spacial coordinate system on the ground must have been based on astronomical observations. In traditional Chinese cosmology different directions corresponded to different seasons, different colors, different elements, and different virtues, etc., which formed the foundation of Chinese ideological and political idea. So "A round heaven and a square earth" had no room to come into existed in Chinese history, in stead, it must be interpreted as "a round heaven and a orientable earth", which reflected the special period when Chinese people began to establish direction system on the ground and orient important buildings by astronomical observations.

Kam-Wing FUNG | The University of Hong Kong, Hong Kong

The transmission of the Islamic astrolabe in Imperial China

An astrolabe imitates the motion of the heavens. Without stereographic projection the astrolabe is inconceivable. It is, however, the origin and development of the method of stereographic projection was unclear. The *Planisphaerium* by Claudius Ptolemy (85?-165) is the only Hellenistic work on stereographic projection that has come down to the present day. This paper will examine the following issues: Hipparchus of Nicaea (190B.C.-125B.C.) and the discovery of stereographic projection; Roman architect Vitruvius (died after 27 A. D.) and the anaphoric clock; Roman portable sundial and stereographic projection; Monophysitist Bishop Severus Sēbōkht (575?-666/667) and Hellenistic-Roman style astrolabe; Persian astronomer Li Su 李素 (?-796), Arabic astronomer Ma Yize 馬依澤 (910?-1005) and Islamic astrolabes; Islamic astronomical bureau at the Mongolian upper capital and an Islamic spherical astrolabe.

Hong-Jin YANG | Korea Astronomy and Space Science Institute, Korea, Republic of

The brightness of the stars recorded in Korean stone star charts

Korea has a long history of star maps over two thousand years. The earliest historical star map is the constellation-like cup marks carved on the cover stone of dolmen, which is a typical tomb of Bronze age in Korean peninsula. And many star paintings are founded in Goguryeo (37B.C.-A.D.668) and Goryeo (A.D.918-1392) tombs. The stars in dolmens and mural paintings have various size. The most valuable Korean historical star map is the stone star chart, CheonSangYeolChaBunYaJiDo (hereafter, SSC), which was manufactured in A.D.1395. From the statistical analysis, it is known that the epoch of the stars carved on the SSC is mixed in the first and fourteenth centuries. There are two SSCs in Korea and the later one is a replica of the original. The replica of SSC was manufactured around seventeenth century. The replica has only one-side star chart while the original has two star charts on the both sides. Each star chart contains 1,467 stars with various size, and the size of stars represents the brightness. We measured the position and the size of stars using 3-dimensional high resolution scanners, Vivid and Breukmann. We find several differences of the position and size of stars among the star charts. We particularly examine the size of star in the star charts and compare it with the brightness of star from Bright Star Catalogue (BSC fifth edition). We will present the variations of the brightness of stars in the star charts.

S092-H. Ptolemy Graecus, Arabus, Latinus, part 1

Wed 24 July, 09:00–10:30 • Schuster Blackett

Chair: Dag Nikolaus HASSE | Julius-Maximilians-Universität Würzburg, Germany

Cristian TOLSA | Universitat de Barcelona, Spain

Evidence and speculation about Claudius Ptolemy's workplace in second-century Alexandria

As is well known, the ancient sources supply only too little biographical information about Ptolemy to form a picture of the immediate context of his scientific activity. The most remarkable reference is a passing observation by the 6th-century philosopher Olympiodorus in his commentary on Plato's *Phaedo*, providing both the length of his career and his workplace. The few scholars that have addressed the subject (Bullialdus, Halma, Letronne, Böll, Jones) have expressed quite different, and non-definitive views on both the reliability of Olympiodorus' account and on the geographical sense of the place he mentions. I will propose here a reexamination of the whole problem based on the analysis of the various possible interpretations, which involves a close look at the Olympiodorus' passage, and at the evidence derived from Ptolemy's work, especially the so-called *Canonica Inscription*. This inscription plays an important role in this context, since it is mentioned by Olympiodorus, and its text as it has reached us through the manuscript tradition does also provide a geographical indication.

As a conclusion I would like to present speculative scenarios for Ptolemy's status as a scientist in second-century Alexandria.

Alexander JONES | New York University, United States

Ptolemy's style and the unity of the corpus

The corpus of texts transmitted under Ptolemy's name includes works surviving in whole or part in Greek as well as works or parts of works that exist only in Arabic or Latin, ostensibly translations of lost Greek originals. The authenticity of some of these texts, for example the *Almagest*, is unquestioned, whereas others are without doubt spurious. Recent opinions by competent scholars have been divided on the authenticity of two works, *On the Criterion* and *On the Governing Faculty*, which is extant in Greek, and *Optics*, which we have only in a Latin translation of a lost Arabic translation. In the present paper I describe certain stylistic elements shared by the accepted Greek works and by the *Criterion*, which are either not found at all in other ancient Greek authors or only in a very few later authors who are demonstrably influenced by Ptolemy. As well as providing a secure standard for establishing common authorship, these enhance our general understanding of Ptolemy's style (as previously investigated by Boll and Stückelberger among others). I conclude with a consideration of the question whether stylistic evidence for authorship can be extracted from the works that are not extant in Greek.

Jean LEMPIRE | Université catholique de Louvain, Belgium

D'Alexandrie à Byzance: la transmission de l'astronomie grecque au VII^e siècle

L'astronomie mathématique de Ptolémée fut une matière abondamment enseignée dans le monde grec de l'Antiquité tardive. La transmission de cette discipline, d'Alexandrie à Byzance, fait l'objet de notre communication : on s'attachera à détailler les acteurs et les modalités de ce phénomène.

À la suite de Théon d'Alexandrie (vers 364), les *Tables Faciles* (*Handy Tables*) de Ptolémée n'ont pas cessé d'être mises en pratique dans les écoles des Ve et VI^e siècles, à Athènes (Proclus, Marinus) et surtout à Alexandrie (Ammonius, Héliodore, Olympiodore). Au début du VII^e siècle, c'est à Byzance qu'un nouveau commentaire aux tables de Ptolémée est composé. Ce manuel, généralement attribué au philosophe Stéphane d'Alexandrie, est une amplification du *Petit Commentaire* de Théon. Il fournit de multiples exemples du calcul astronomique, datés des années 617 à 619. En outre, l'auteur emploie des tables adaptées au climat de Byzance, qu'il déclare avoir créées afin

de simplifier les calculs. Le texte est donc un excellent témoin de l'emploi des *Tables Faciles* au VII^e siècle byzantin et témoigne de la migration du savoir scientifique, de l'école d'Alexandrie à Byzance. Largement copié et diffusé aux XIV^e et XV^e siècles (renaissance byzantine), le manuel de Stéphane souligne à cette époque le renouveau de l'étude de Ptolémée, notamment dans les cercles intellectuels de Théodore Métochite, Nicéphore Grégoras et Isaac Argyros.

S. Mohammad MOZAFFARI | Research Institute for Astronomy and Astrophysics, Maragha, Iran

Ptolemaic orbital elements of the inferior planets: the eccentricity of Venus in medieval Islamic astronomy

The present study aims to evaluate the accuracy of the values obtained in the medieval Islamic astronomy for the Venus' eccentricity. With transforming the heliocentric orbital elements of the planet to its geocentric ones, the below polynomials as a function of the time (counted in Julian days) remained to or elapsed from 1 January 2000 are produced for the geocentric eccentricities of the deferent e_1 and of the equant e_2 , and the longitude A of the apogee (the radius of orbit $R = 1$):

$$e_1 = 0.01263567028 - 0.0003177437352 \cdot t - 0.000003472804123 \cdot t^2$$

$$e_2 = 0.01641895960 - 0.0003272424646 \cdot t - 0.00002041205570 \cdot t^2$$

$$A = 92.25290697 + 18.78218517 \cdot t + 0.05501188560 \cdot t^2 - 0.00007412766659 \cdot t^3$$

Since the eccentricity of the Earth/Sun remains more than two times as large as the Venus' heliocentric eccentricity, e_1 and e_2 are both much related to the first. Due to the smallness of the Venus' heliocentric eccentricity, the geocentric apsidal line of the Venus remains closer to the Earth's apsidal line than that of any other planet: the angle between them changes from 13.8° in AD 0 to 10.7° in AD 2000. e_1 and e_2 decrease with the passage of time. Nevertheless, since the rate of decrease is negligible ($\approx 3 \cdot 10^{-4}$ in a millennium or about 0;1 in a millennium with the Ptolemaic norm $R = 60$), the ratio e_1/e_2 remains nearly constant, ~ 0.8 , during the two millennia.

Ptolemy found out $e = e_1 = e_2 = 1;15$ (the orbit's radius $R = 60$) and the Venus' apogee remains behind the solar apogee. The early Islamic astronomers believed that Venus' apsidal line coincides with that of the sun/Earth, and their maximum equations of centre (namely, their eccentricities) are identical. The idea roots in Indian astronomy and penetrated into Islamic astronomy through pre-Islamic Persian astronomy. Since the geocentric apsidal line of Venus is very close to the solar/Earth's apsidal line, it is imaginable that somewhere (either in Indian astronomy or its Greek antecedents) the careless observations would have resulted that the two coincide with each other (perhaps, to distinguish between the directions of the two may be counted as another contribution of Ptolemy to the planetary astronomy). The idea was rendered obsolete in Islamic astronomy after the 11th century.

Whether or not the values adopted for the Venus' eccentricity in the Islamic astronomical tables are equal to half the solar eccentricity, they are between 1;2 and 1;3, and remain very close to the solar/Earth's eccentricity at the time. The only exception is Ulugh Beg's remarkable value 0;52 which is close to the average of the values of e_1 and e_2 at the time. Nevertheless, to hold the opinion of the Venus' eccentricity being lesser than the Sun's may be considered as an achievement of the late Islamic astronomy.

S092-J. Ptolemy Graecus, Arabus, Latinus, part 2

Wed 24 July, 11:00–12:30 ▪ Schuster Blackett

Chair: Raymond MERCIER | University of Cambridge, United Kingdom

Dag Nikolaus HASSE | Julius-Maximilians-Universität Würzburg, Germany

An introduction to the 'Ptolemaeus Arabus et Latinus' project of the Bavarian Academy of Sciences

For 25 years, from 2013 to 2038, the Bavarian Academy of the Sciences in Munich will be hosting a project which is concerned with editing and studying the astronomical and astrological heritage of Ptolemy in the Islamic world and Christian Europe up to the 17th century. The central aim of the project is to provide a new textual foundation for our understanding of the Ptolemaic tradition. To this end, the project will retrieve the Arabic and Latin versions of the *Almagest* and *Tetrabiblos*, of Ptolemy's minor works, of Pseudo-Ptolemaica and of the commentary literature in its manifold forms. The result of this work will be made accessible in the form of online presentations of manuscripts, searchable texts and technical tools. Critical editions, catalogues and studies will appear in the publication series *Ptolemaeus Arabus et Latinus*. Chief members of the project team are – apart from me – David Juste and Benno van Dalen. However, retrieving the Ptolemaic tradition will involve many more scholars. The project's publication channels, in print as well as on the website, are open to refereed work from all colleagues working on the Ptolemaic tradition.

Benno VAN DALEN | Bavarian Academy of Sciences and Humanities, Germany

Ptolemy's astronomical heritage in the Islamic Middle Ages

This talk presents a preliminary overview of the Islamic tradition of mathematical astronomy based on Ptolemy's *Handy Tables* and *Almagest* and sketches some of the developments that took place within this tradition. The overview includes, in particular, the Arabic and Persian commentaries on the *Almagest* and the category called *zij*, astronomical handbooks with tables that were influenced by the *Almagest* in some respects and by the *Handy Tables* in others. The attempts by Islamic astronomers to modify Ptolemaic astronomy, especially the *hay'a* tradition and Ibn al-Shatir's *New Zij*, will be briefly indicated.

Charles BURNETT | Warburg Institute, United Kingdom

Ptolemy's astronomical heritage in medieval Europe

This paper will summarise our current knowledge of the translations of Ptolemy's *Almagest* into Latin in the Middle Ages, including especially the latest research on the 'Dresden *Almagest*' by Dirk Grupe, and my own research on the 'Sicilian *Almagest*' attributed, confusingly, to Hermann of Carinthia. Also included is the *Almagestum Parvum*, the earliest *Theorica planetarum* and the *30 Chapters* of al-Farghani, which, together with the translations of the *Almagest* itself, establishes the basis for Ptolemaic astronomy in the Middle Ages.

David JUSTE | Bayerische Akademie der Wissenschaften, Germany

Ptolemy's astrological heritage in medieval and Renaissance Europe

The aim of this paper is to introduce the astrological texts which circulated under the name of Ptolemy in the Latin tradition. About twenty such texts are known at present, two of which stand out as the most popular among all the works attributed to Ptolemy: the (authentic) *Quadripartitum* and the (spurious) *Centiloquium*. The former was translated into Latin at least nine times between 1138 (Plato of Tivoli) and 1553 (Philipp Melancthon), and the latter at least seven times between Adelard of Bath in the 1120s (?) and 1477 (Giovanni Pontano).

S093. New perspectives on classification and methodology in history of science: theoretical and technological bases for managing primary sources

Sponsoring body:

DHST Bibliography and Documentation Commission

Thu 25 July, 09:10–12:40 • Roscoe 2.3

Symposium organisers:

Ana Maria ALFONSO-GOLDFARB | Pontifícia Universidade Católica de São Paulo, Brazil

Georges MÉTAILIÉ | Centre Alexandre Koyré, France

Symposium abstract

Global access to information poses a series of problems to researchers in the history of science, technology and medicine (HSTM). In particular, the lack of an adequate system of classification of the sources needed for research makes this situation even more complex. The traditional division of the sciences into the modern areas leads to severe distortions and anachronism. Full fields of knowledge predating modernity cannot find a place in the available classifications.

A similar process occurred at the very inception of modern science, when the older order of knowledge was replaced by a project that sought to make the new knowledge available in a complete and organised manner to the ever-increasing number of potentially interested users. The "tree of knowledge" was thoroughly revised and many attempts were made at redesigning it. Branches that had lost their original function still remained in their traditional location, whereas branches considered secondary up to that moment came to the foreground as a function of their hybrid nature, and fully novel and incipient branches burst out everywhere, but more particularly on top of or from within the traditional ones, which lent them body and structure.

Modern reorganisation of knowledge was expectably chaotic, and extended well into the 19th century, when modern specialisation acquired its current contours. However, change did not only require time, but also new syntaxes able to reflect the new modes of thinking and communicating in science. The reformulation of notions, and thus also of language played a crucial role for the new science to follow specific and specialised paths.

The aim of the present symposium is to discuss the classification of sources for the history of science in order to contribute to the construction of searching tools better attuned to the needs of scholars in the 21st century on a multidisciplinary basis. For this purpose, significant attention will also be paid to the particular problem posed by the so-called "primary sources" whose place in modern classifications ("trees of knowledge") is difficult to establish.

S093-A

Thu 25 July, 09:10–10:40 • Roscoe 2.3

Chair: Stephen WELDON | University of Oklahoma, United States

Ana Maria ALFONSO-GOLDFARB | Pontifícia Universidade Católica de São Paulo, Brazil

Marcia H. M. FERRAZ | Pontifícia Universidade Católica de São Paulo, Brazil

Silvia WAISSE | Pontifícia Universidade Católica de São Paulo, Brazil

Rethinking organization of knowledge in digital times

Since the very inception of History of Science as a modern discipline, there was a concern with the organization of knowledge. The dialogue held by historian of science George Sarton and bibliographer Paul Otlet represents an illustrative example of this concern in the early decades of the 20th century. It is no reason for surprise then, that the classification developed by Sarton for *Isis* bibliography shared some common elements with the *Universal Decimal Classification* formulated by Otlet and Henri Lafontaine, more particularly, the place of disciplines as the backbone of classification.

However several factors were identified that make discipline-based classifications problematic. First the intrinsically interdisciplinary nature of History of Science itself, which crosses over at least history, philosophy, and the sciences themselves. Then, the historical trajectory of scientific disciplines, because as newer and more specialized disciplines emerge, other and more older ones become outdated, to disappear from the so-called “trees of knowledge”. Finally, the fast development of fields of knowledge crossing over disciplinary borders.

At the time when the main concern of bibliographers was how to place books and other documents in actual library shelves, that problem could hardly be addressed. However, the situation changed dramatically together with the introduction of information technology (IT), and the development of relational databases.

In the 1920s, Indian mathematician R. S. Ranganathan, after a season of training as bibliographer in London, developed a proposal for organization of knowledge based on strains of facets articulated by means of logical operators that transcends the rigid borders of disciplines and fits with the ethos and patterns characteristic of our “digital world”.

Repositories of primary sources for studies in History of Science might benefit from the application of facet-based classifications. In the present study, we address the application of faceted classification to one such specific repository, namely the one of Center Simão Mathias of Studies in History of Science (CESIMA), Pontifical Catholic University of Sao Paulo (Funding: CNPq 474061/2010-8; FAPESP 2011/14040-9; CNPq 309691/2011-7).

Georges MÉTAILIÉ | Centre Alexandre Koyré, France

Filing or taxonomy: the case of Li Shizhen (1518-1593)

In different papers the classification of *materia medica* by Li Shizhen (1518-1593) is considered as analogous to a modern taxonomy, even more accurate than the one by Linnaeus. In anyway, it is considered as representing the highest level of the classification of natural objects in ancient China.

I propose to appreciate the consistency of these statements through the analysis of the arguments of modern authors in favor of the previous point of view on one hand, and by presenting Li Shizhen’s own point of view in his *Bencao gangmu* (Classification of *materia medica*) (1596), on the other hand.

On this basis, several examples of different way of filing natural objects in Chinese texts (pharmacopeias, agricultural or horticultural treatises, literati’s notes...) will be taken into consideration.

In conclusion, I would like to insist on the danger of a teleological vision in the history of ancient scientific knowledge.

Carla BROMBERG | Pontifícia Universidade Católica de São Paulo, Brazil

CESIMA’s project of classification: a case study with sixteenth-century documents

As it is known, the *ISIS* bibliography was first indexed according to a classification system originally developed by George Sarton. Sarton’s system was derived from his notions of time period and scientific disciplines. Following him, Magda Whitrow was invited to work with the cumulative bibliography. She had then created an indexing system- thought to supplement his initial classification- which was a facet system of classifying entries based on the facets of a subject. Steve Weldon had developed it into seven facets, and transformed in a way to improve the system. As Whitrow reminds us, Sarton’s classification had already an implicit facet classification in it. The faceted classification theory- as developed by S.R.Ranganathan in his *Colon Classification*, have been extensively used for research focused in knowledge classification and information systems. Alongside his philosophy, facet theory was also developed by the Classification Research Group in UK, which has been providing guidelines in dealing with documentation for the construction of facet-based systems.

In CESIMA, a pilot project has been developed to discuss how facet theory can be applied in creating a new system of classification for the History of Science. Special attention in this paper will be given to classifying documents of the Renaissance, more specifically documents where Musical knowledge, Mathematics and Natural Philosophy coexist. The difficulties found within the classification of such documents concern misleading classification of content subject, misleading terminology in choosing descriptors as misleading abstracts for catalogation. While this is a working progress project, yet the difficulties found in classifying these documents are outspoken. The difficulties with the classification of these type of documents can be also found while searching for similar content documents either in libraries, or in the internet databases. This selection of documents has proved to be a particular good sample for the development of the tools and philosophies of our project. This paper aims at providing some of the outlines and the initial problems found in applying and developing CESIMA’s classification in such specific documents in the History of Science. (Funded by FAPESP 09/52252-8).

S093-B

Thu 25 July, 11:10–12:40 ▪ Roscoe 2.3

Chair: Silvia WAISSE | Pontifícia Universidade Católica de São Paulo, Brazil

Thomás HADDAD | Universidade de São Paulo, Brazil

Making sense of seventeenth-century Iberian science through printed books: methodological and theoretical issues

In the last decade or so, early-modern “Iberian science” has come to occupy a highly visible position in the research agendas of the international history of science community, along with renewals of long-standing traditions of scholarship carried on by Spanish and Portuguese scholars. This surge of interest in the processes of production of natural knowledge in early-modern Spain and Portugal constitutes an attempt to go beyond the “Black Legend” of Iberian backwardness, religious fanaticism and intellectual conservatism, and much has been done to properly situate the region’s scientific output in relation to its actual historical horizons and larger-scale trends. Presently, the 16th and 18th centuries command most attention, the former because of the context of the maritime discoveries and the zenith of Iberian political power, the latter because of what are perceived as conscious projects of reform and modernization carried out by regional elites. The 17th century still remains, however, much prone to be explained in the idiom of decline and its usual narratives. In this paper we address the question of how the systematic study of scientific books printed in the region during the century, which we are presently undertaking, may contribute to a better understanding of the processes, actors and institutions involved in the making of natural knowledge. Although there are some bibliographical repertoires and databases, there still lacks a systematic survey of this output, going beyond mere listings. We delineate the challenges of

building a historically sound typology of such material, one that incorporates locally recognized “trees of knowledge” and library-classification schemes. We then argue that, although classifying (and quantifying) the printed sources may help one to gauge the decline thesis, through comparative analyses (internal and external, as well as synchronic and diachronic), proper historical understanding of Iberian science in the period demands several additional steps, that must be incorporated in such a systematic undertaking: As a minimum, one has to map trends and shifts in printers and printing centers, authors’ interests and institutional backgrounds, and patronage dynamics (through prefaces and dedications). The construction of proper time-frames and benchmarks for the establishment of such trends is finally discussed, as well as a last, crucial question: the incorporation of readers and networks of circulation into the analysis.

María Blanca RAMOS DE VIESCA | Universidad Nacional Autónoma de México, Mexico

The 1950 poliomyelitis epidemic in Mexico, its control and the Sabin vaccine development: a case study based on primary sources

In 1950 a severe poliomyelitis epidemic was developed in Mexico. In 1946 was reported the first case, but in 1950 the multiplicity and the severity of cases obliged the authorities to install an special service at the *Hospital Infantil* of Mexico City, supplied with an intensive care unit with pulmotors and to develop a campaign isolating sick children and caring them with general measures and physiotherapy. In 1952 the epidemic goes down, but poliomyelitis became endemic. Some surgical procedures to permit a better rehabilitation was designed and soon came the Salk vaccine to provide bases to a preventive approach. In 1954 Sabin started his work in preparing and producing a live virus vaccine, always working near Mexican sanitary authorities, to finally develop a successful national vaccination campaign in 1959. In this paper we describe this events and present considerations about poliomyelitis control and eradication in Mexico, through the study of primary and inedited documentation.

This presentation is based on work co-authored by Carlos Viesca.

Floriano Jonas CESAR | Universidade São Judas Tadeu, Brazil

Crossing borders: medical ideas in late medieval non-medical areas

The presence of medical ideas in medieval political texts is well known since at least the pioneering works of Otto Gierke in the nineteenth century. In the last decade, the increasing number of digital libraries and the development of electronic searching tools have empowered research in this field. In a test case, this paper will use some of these new resources to show a wider-than-acknowledged influence of scholastic medicine on politics during the years between 1270 and 1370, a key century in the development of political science. Furthermore, we will argue that medical ideas played a role which was not simply illustrative but argumentative in these political works. Being so, they posed both epistemological and methodological issues as well as raising questions about the connections between sciences.

Piyo RATTANSI | University College London, United Kingdom

‘Animal alkahest’ at the early Royal Society and the dilemmas of classification revisions

In a paper published in the *Notes & Records of the Royal Society* in November 2010 (Alfonso-Goldfarb, Ferraz and Rattansi, Lost Royal Society documents on ‘alkahest’ (universal solvent) rediscovered, vol. 64: 435-456) we discussed the rediscovery of documents connected with three meetings of the early Royal Society (1661) devoted to an experiment to demonstrate that a counterpart of the alkahest or universal solvent was present in the newly discovered lymphatic vessels. Although the minutes published in Birch reproduce the Minutes, it was difficult to

reconstruct the discussions without access to the papers mentioned in these Minutes. However, those primary sources had themselves been filed and refilled by Royal Society cataloguers over the subsequent centuries, as the sciences became increasingly specialised. The task of recovering them and of identifying the author proved laborious and often led into blind alleys.

Specialisation among historians of science, too, contributes to difficulties in researching a subject like the ‘alkahest’. The word originated with Paracelsus, as a remedy for liver disease, but it was transformed into a ‘universal solvent’ by his great ‘iatrochemical’ successor, J.B. van Helmont. For him it was both a proof that all earthly things are made from water and as providing the most effective remedy for all diseases (since it recovered from all substances their therapeutically most effective constituents). R. Boyle provisionally accepted the belief and H. Boerhaave was to treat it at length in his *Elementa chemiae*.

Placing the Royal Society discussions in their contemporary scientific and cultural context demanded immersion in the development of post-Vesalian anatomy and physiology which led to the discovery first of Harveian blood circulation and then of the lymphatic system. T.L. Kohlhans, whom we identified as the author of the ‘animal alkahest’ paper, could then be seen as arguing that the purpose of that system was not merely to carry pure water or ‘lymph’, but to extract the ‘seminials’ from the ingested nutriment (chyle) and distributing them to bodily parts. Kohlhans was thus using the Helmontian alkahest to answer a puzzle about the function of the lymphatic system.

Our researches for the recovery of the lost papers illustrate vividly the difficulties that changing subject classifications raise for research in primary sources and, in conclusion, we shall raise some wider considerations based on our own experience.

S094. History of science and the ecology of knowledge: the limitations, expectations, and needs of four knowledge communities

Sponsoring body:

DHST Bibliography and Documentation Commission

Fri 26 July, 11:00–15:30 • Uni Place 3.204

Symposium organisers:

Birute RAILIENE | Wroblewski Library of the Lithuanian Academy of Sciences, Lithuania

Stephen WELDON | University of Oklahoma, United States

Symposium abstract

This symposium explores how HSTM resources (archives, bibliographies, secondary scholarly works, etc.) are related to four communities - scientists, historians, educators, and laymen - each of which both uses and produces historical materials of different types. The symposium papers will analyze the different roles that HSTM resources play in the ecology of knowledge among these communities. The practical outcome of the symposium will be a published collection of papers and a set of recommendations for better tools to meet the needs of these four groups. Only by understanding the place of HSTM in the global ecology of knowledge can we move forward coherently.

The four groups each have unique limitations, expectations, and needs. This means that effective scholarly tools and resources can only be developed around the unique conditions of each community. For the

scientific community, HSTM functions as a historical conscience. It relies upon HSTM for its memory and self-understanding. Scientists, of course, are also producers of primary-source content that HSTM must help preserve and make accessible in the form of libraries, archives, museums, and so forth. Finally, sometimes scientists become historians in their own right, producing self-reflective analysis.

Historians form the core of HSTM, we produce secondary resources of many kinds using the specialized methods of our discipline. We rely on HSTM tools for our very livelihood. Archives, bibliographies, and access to textual and non-textual resources are required for everything that we do. Moreover, everything that we produce is an HSTM resource of one kind or another, whether it be a tool, such as a finding aid, or a secondary source, such as a scientific biography.

Educators (from primary school teachers to university professors) use HSTM resources to explain and teach both scientific and humanistic aspects of our cultures. These educators (and, increasingly, their students) also produce teaching resources that HSTM must acknowledge and sometimes preserve.

Finally, the lay public (from politicians and bureaucrats to local news media) often seeks the aid of HSTM. The significance of well-researched and accurate material affects everything from entertainment (expert consultants on feature films, for example) to determining public policies. Many products generated in these popular settings must also be treated as objects of study within HSTM. They, too, are part of this global ecology of knowledge.

The symposium will address these topics in specialized papers related to different communities and different sorts of HSTM resources. We expect that at least two papers will attempt to explore the topic broadly, developing a vision for HSTM resources for the next decade and a blueprint for goals to be adopted by the Commission

S094-A

Fri 26 July, 11:00–12:30 • Uni Place 3.204

Chair: Birute RALIENE | Wroblewski Library of the Lithuanian Academy of Sciences, Lithuania

Annie JAMIESON | University of Leeds, United Kingdom

Exploiting the ecology of knowledge: how counterfactual history of science can inform contemporary genetics pedagogy

As many commentators have noted, over-simplification of genetic concepts, by scientists, educators and the media, can lead to an overly deterministic view of the role of genes in health and disease, which can affect citizens' decision making with respect to genetic issues. Thus this problem concerns all four of the communities addressed by this symposium. This paper will focus on a project that is both instantiation and product of the 'ecology of knowledge' that arises through the interaction of these communities. As a historian of science, I am drawing on historical and contemporary primary scientific sources (print and archive) to design and deliver an alternative curriculum for teaching introductory genetics to first year undergraduates, which aims to address some of the common mis-conceptions that can arise from traditional teaching methods. In so doing, I engage with historians, scientists (past and present) and educators and with the knowledge resources that they produce, with the aim of producing new resources for the use of all these communities. The experimental curriculum employs a historically-informed, interactionist emphasis (based significantly on the unpublished work and correspondence of the biometrician, W. F. R. Weldon) to facilitate a more subtle and less deterministic view of genetic issues for students. In this paper I will discuss the ways in which this project fruitfully utilises the 'ecology of knowledge' to fulfil its aims and demonstrate how, as historians, we can meaningfully contribute to and

encourage dialogue between different communities, with practical benefits outside the academy.

HAKKARAINEN Jussi-Pekka | National Library of Finland, Finland

Making the impact on research and society, a case study: open repository and crowdsourcing solutions developed for the Finno-Ugric Digitization Pilot Project at the National Library of Finland

The key objective of the Finno-Ugric Digitization Pilot Project is to support a culture of openness and interaction in linguistic research, but also promote the crowdsourcing (or citizen science) as a tool for the participation of the language community in research. This target demands the unlimited availability, accessibility and usability of source material and research results via open repository as well as the participation of the language community in various stages of documentation and application of research results.

In May 2012, the National Library of Finland was awarded a grant for producing the research material and infrastructure required by the Kone Foundation in order to meet the objectives of its Language Programme. In order to meet the prerequisites of the Language Programme, Mari and Mordvinic newspapers from the 1920s and 1930s as well as a selection of Veps and Ingrian books were chosen for digitizing from the collections of the National Library of Russia in St. Petersburg.

The material digitised for the Pilot Project was published* through the open repository designed and maintained by the National Library of Finland. This approach allowed the digital material to be available for open use by the public while ensuring access to the academic community to use the language materials in research. In addition, crowdsourcing tools and resources were created for the material in conjunction with its publication.

When modelling the Pilot Project, it was essential to take into consideration the needs of the researchers and to have them participate in the planning and execution of the project from the very beginning. By implementing the feedback iteratively from the researchers, we were capable to transform the requested changes as tools for research that not only supported the work of linguistics, but also encouraged the laymen, or citizen scientists, to face the challenge and work with the crowdsourcing tools for the research's benefit.

In this presentation, we won't be discussing only the aspects, developments or achievements of technical infrastructure of our open repositories, but we would like to highlight the process, in which the user groups, the researchers and the laymen, were engaged in a process as an active and communicative group of users and how the contribution of citizen science was made as research's benefit.

*due to the copyrights, the service will be available for the public as of spring 2013 onwards.

This presentation is based on work co-authored by Leena Saarinen.

Stephen WELDON | University of Oklahoma, United States
Amy RODGERS | University of Oklahoma, United States

Digital perturbations in the ecology of knowledge: exploring differential usage of the Isis Current Bibliography in both print and digital forms

The Isis Current Bibliography has been in existence for 100 years. It was one of the foundations upon which the discipline of history of science was built, especially in the eyes of its founder, George Sarton. Up to now, there have been no careful studies of the actual use of the bibliography, and this paper seeks to explore data from a survey of historians of science that will be conducted in the spring of 2013 regarding the nature of usage of the Isis Bibliography. The present moment presents a particularly interesting time for measuring usage

because we are at a nexus between two radically different kinds of research environments, one based on print and the other based on digital forms. Most scholarship these days is of some hybrid nature. Moreover, the Bibliography exists in three distinctly different formats, one print and two electronic, and it has had a digital presence for over twenty years, which means that scholarly use of the digital format has had a chance to become well established over that time. The survey of users will be able to explore ways in which digital tools and print tools are differently used, and will analyze disciplinary and demographic differences in the types of research conducted. Because scholars are frequently also teachers, the survey will also explore ways in which the Bibliography has been used in educational settings. The survey will make a careful attempt to differentiate institutional affiliations, so that education and research missions of institutions can be taken into account. In the end, we expect to be able to see patterns of use that will indicate how the digital, networked information environment has changed and is continuing to change the ecology of knowledge in the discipline. Since the Bibliography has played a central role in the disciplinary formation of the history of science community, we will also be looking for evidence about how that role has changed and developed over time by studying historical evidence in relationship to the survey results.

S094-B

Fri 26 July, 14:00–15:30 ▪ Uni Place 3.204

Chair: Stephen WELDON | University of Oklahoma, United States

Simon CHAPLIN | Wellcome Library, United Kingdom

Doing public history in an age of open access

Over the past ten years libraries, archives and museums have embraced digitisation as a means of getting relatively inaccessible and little-used research collections out into the world. At the same time, researcher funders and institutions - especially in the biomedical sciences - have adopted policies to support open access (OA) to publicly-funded research, mostly in the form of journal articles. But while commercially-funded digitisation projects have often been built for well-defined and long-established 'target audiences', publicly- or charitable foundation-funded digitisation has often been accompanied by more nebulous ambitions to 'engage' with lay audiences. Crowd-sourcing and co-curation models have been applied in an attempt to turn 'engagement' with digital content into a more democratic process: forms of 'public history' that blur the boundaries of history as an academic discipline. This paper explores these issues in relation to the Wellcome Library's digitisation programme, and highlights some specific issues arising from history of medicine's essentially trans-disciplinary character, straddling medical science and the humanities. It argues that if the potential of digitisation to engender meaningful forms of 'public history' is to be realised, greater emphasis must be placed on making the range of outputs arising from scholarly research available to audiences outside the academy. In particular, it highlights the growth of bibliographic databases linked to full-text OA repositories as an opportunity and a challenge to the HSTM research community, specifically in the context of programmes of public history linked to digitised primary resources.

Birute RAILIENE | Wroblewski Library of the Lithuanian Academy of Sciences, Lithuania

Scientific biography as a source for the history of science on the open-access internet

Biographical information is one of the most valuable sources for the history of science. The role of personality is hard to overestimate in understanding the development of social structures within the scientific enterprise. But the sources of biographical information are complex. The portrait of person can be found not only in biographical monographs, but also in scholarly writings, conference papers, archival collections of

letters and documents. We can even find biographical information in such places as fiction and poetry.

This paper aims to discuss the difficulties of dealing with authority files for open access resources related to biographical research in history of science. It seeks to reveal contemporary challenges and future expectations to the biographical research.

When doing research through Internet-based resources, depending on the type of search performed, very different results will be returned. The fastest and easiest searches start with Google or Wikipedia; more advanced and professional searches include subject databases and biographical sources of learned societies. The most thorough searches will generally involve paid resources.

This paper will discuss authority files (such as the Library of Congress Authorities at <http://authorities.loc.gov/>) and the name Authorities Co-Operative (NACO) (see <http://www.loc.gov/aba/pcc/naco/>), the latter of which is a component of the Program for Cooperative Cataloguing. It is proposed that these authority tables can be of use in biographical searches.

The main idea of cooperative cataloguing is to unify authority data around the world. The main point of using authority files is to link authors' names to the proper person when there are a variety of spellings and when coincident given names complicate the search.

Library catalogues already have a careful way of dealing with these problems. Normed names in authority files are easily connected to all authors' entries within electronic library catalogues, which means that it is relatively easy to obtain a ready list of an author's scientific output. However, there is currently no good system for dealing with authority names on the open Internet.

This paper concludes with a series of questions and lines of discussion relating to developing and extending a more coherent searching system through the open access sources beyond the library catalogs. It proposes that these be addressed in the next four years by the Commission on Bibliography and Documentation of the IUHPS/DHST.

Urs SCHOEFLIN | Max Planck Institute for the History of Science, Germany

Challenges for the humanities: scholarly work and publishing in the digital age

Since the foundation of the Max Planck Institute of the History of Science in 1994, it is one of the Institute's concerns to make primary source materials available in digital form together with developing advanced tools and instruments to adequately support scholarly work. ECHO - Cultural Heritage Online (<http://echo.mpiwg-berlin.mpg.de/home>) as an open access repository and research environment is the most prominent outcome of this endeavor. Based on this experience, issues of motivation, collection building strategies, specific tool development, open access as primary prerequisite (Berlin Declaration; <http://oa.mpg.de/lang/en-uk/berlin-prozess/berliner-erklarung/>), research collaboration and trans-disciplinarity will be raised. With ECHO it has become possible to change the traditional ways in which scholarship in the Humanities is documented and to make research results more transparent. Reflecting on changing notions of "the document" and on information economy, novel ways of disseminating research results will be presented (e.g. Edition Open Access; <http://www.edition-open-access.de/>). Finally, problems of organizing quality control, of long-term sustainability, and of gaining recognition in evaluation procedures will be addressed.

Gavan MCCARTHY | University of Melbourne, Australia

Finding an eco-historical niche: the World History of Science Online as a complex historical network

The World History of Science Online (WHSO) is a project of the Commission on Bibliography and Documentation (CBD) of the International Union for History and Philosophy of Science, Division of

History of Science and Technology. It had its genesis in 2003 as a primary focus and public output of the CBD but it would be reasonable to say that for the last ten years it has struggled to define its purpose. Professor Rod Home, a former President of the CBD described one of the key roles of the commission the creation of an international catalogue of bibliographies. Early attempts to consider a merging of national bibliographies proved both technically and informatically unachievable and this remains the case. From a cultural and social informatic perspective the very notion of creating universal catalogues remains problematic. However, this does not lessen the need for information services to aid, foster growth, and bring productivity gains to the study of history of science and technology. Although funding has been limited the WHSO exists as a public knowledge web resource built to principles geared to underpin sustainable and resilient web-based scholarly information services. The underlying informatics of the resource utilise an open and extensible object-oriented structure that enables entities (people, organisations, events, places, cultural artefacts and concepts) to be registered and then interconnected using defined relationships creating what some have described as an epistemic web or network. A key to the success of projects that have used this approach has been the systematic linking of entities to the evidential sources (archives, records and publications) that are testimony to their existence and the activities they undertook. In 2012, Stephen Weldon presented a paper in Athens that took as its starting point the history of the history of science and in particular the work of George Sarton and the creation of the ISIS bibliography in 1913. What Weldon identified was that the key aspect of WHSO that was lacking was that it had not attempted, in a systematic and concerted way, to map the historical fabric that supports and provides meaning to the bibliographic and archival work in this history of science and technology. This paper will explore the eco-historical niche that is now being mapped out. It will examine, and present in visualisations, the types of entities and types of relationships that are necessary to make this historical space navigable.

S095. Using modern computing power to analyse and explicate ancient astronomical sources: opportunities and challenges

Sponsoring bodies:

CHAMA: DHST Commission for the History of Ancient and Medieval Astronomy

DHST East Asia Commission

Thu 25 July, 09:00–12:30 • Uni Place 2.218

Symposium organisers:

Christopher CULLEN | Needham Research Institute, United Kingdom

Matthieu HUSSON | Université Paris Diderot - Paris 7, France

Symposium abstract

Historians of astronomy use many different types of sources to analyze the ways in which ancient people interpreted what they saw in the sky and how they attempted to predict what they might expect to see in the future. Despite important contributions made by the study of ancient material objects and architectural structures relating to the heavens, the most significant sources still are written texts. Amongst such texts, those containing numerical data and calculations have been the focus of major research efforts. This symposium will offer a forum for specialists from a wide variety of backgrounds to discuss the opportunities offered by the power and flexibility of modern computers and their software to deal with

ancient numerical material as well as the risks and problems that may follow from such approaches.

Although extensive quantitative analysis of ancient numerical material has been used at least since Kügler and Neugebauer applied it to the study of Babylonian astronomy more than a century ago, in the last 30 years there has been an explosion in the number of publications involving the use of computer-based quantitative analysis. The symposium will seek to take stock of what has been learned across the disparate areas of an emerging community that so far has had little chance to gather. Some historians have developed very general methods of analysis applicable to a wide variety of cases in order to survey large bodies of sources; others have concentrated on developing tools that give precise insights into specific sources. A collective discussion of this particular issue may open new methodological directions and help to integrate both approaches in a fruitful way.

The wider audience of historians of science has often responded ambivalently to these quantitative methods of analysis. On the one hand, many agree that we should make the best possible use of what computer-assisted analysis of historical sources can provide. On the other hand, some skeptics fear that a “technical smoke screen” may mask conclusions that lack historical or cultural sensitivity. Organizing this symposium during the ICHST will create a unique opportunity to address such issues, which impact not only ways in which quantitative analysis should be presented in publications but also possible articulations between these numerical methods and the more familiar analytical tools of the historian of science.

S095-A

Thu 25 July, 09:00–10:30 • Uni Place 2.218

Chair: Matthieu HUSSON | Université Paris Diderot - Paris 7, France

Glen VAN BRUMMELEN | Quest University, Canada

Tools of the table crackers: a survey of the application of quantitative methods in the history of numerical tables

The application of quantitative methods as a research tool in the history of the exact sciences in recent decades has been powerful, tempting, and fraught with danger. Given their structure, historical numerical tables provide a proving ground for quantitative analysis and a potential for insights concerning historical treatises, authors, and users; but these methods may be applied only extreme caution and vigilance. We shall survey attempts to “crack” historical numerical tables, attempting to classify the various goals of researchers, elucidating their methods, and exploring the historiographic implications. This paper represents joint work with Clemency Montelle, Matthieu Husson, and David Bellhouse, and is part of the “Histoire des Table Numériques” project.

Mathieu OSSENDRIJVER | Humboldt-Universität zu Berlin, Germany

Working with tables: Babylonian mathematical astronomy

Cuneiform tablets from the Late-Babylonian period (400-50 BCE) contain the earliest known form of mathematical astronomy in the ancient world. The tablets can be divided into approximately 360 tables with computed data for the Moon and the planets, and approximately 110 procedure texts with corresponding computational instructions (for the latter cf. Ossendrijver 2012, ‘Babylonian Mathematical Astronomy: Procedure Texts’). A distinctive feature of Babylonian astronomical tables is that their columns contain not only final results, i.e. empirically meaningful quantities that do not serve as input for further computations, but also numerical data pertaining to intermediate steps of the underlying algorithms. The reconstruction of the algorithms underlying Babylonian astronomical tables therefore proceeds by analysing the individual

columns and the possible connections between them. I begin this paper by discussing some of the existing methods for analysing Babylonian astronomical tables that were developed by Otto Neugebauer and other pioneers of the field, and the ways in which these methods have affected our view of Babylonian mathematical astronomy and its conceptual framework. As I will argue, certain distortions resulting from the strong emphasis by the pioneers on using modern mathematics for table crunching have begun to be corrected only in recent years. I will then discuss some of the more recent methods for tabular analysis that have become possible only with the advent of modern computers.

Christopher CULLEN | Needham Research Institute, United Kingdom

Making 'live' translations of Chinese astronomical systems with Excel

From the beginning of the Christian era, onwards, we have a number of very clearly specified descriptions of Chinese systems of astronomical calculation prepared for calendrical purposes. These typically take the form of lists of named constants, a specification of a set of initial conditions, and sequential instructions for calculations which will yield data for solar, lunar and planetary positions at any instant thereafter. A number of authors have published discussions of such systems, accompanied by full or partial translations. In this paper I shall discuss the use of Excel spreadsheets to construct a new form of translation, in which the original text and its English translation are inserted into Excel spreadsheets embodying simple formulae that perform each step of the calculation specified. Construction of such spreadsheets can be a useful research tool in analysing the system translated, but can also add a helpful dimension to the reader's understanding of the text, since the translation not only specifies what should be done but also shows what is done as the complete set of calculations is carried out for any date specified by the user.

S095-B

Thu 25 July, 11:00–12:30 ▪ Uni Place 2.218

Chair: Christopher CULLEN | Needham Research Institute, United Kingdom

Clemency MONTELLE | University of Canterbury, New Zealand

Bhaskara II's *Brahmatulyasarini*: the challenges arising from a preliminary quantitative analysis of a set of second-millennium Indian astronomical tables

A twelfth century set of astronomical tables, the *Brahmatulyasarini* by Bhaskara II (b. 1114), poses some interesting challenges for the modern historian. While these tables exhibit a range of standard issues that numerical data typically present, their circumstances and mathematical structure are further complicated by the fact that they are a recasting of another work by Bhaskara II that was originally composed in verse, the *Karanakutuhala* (1183). With almost no accompanying explanation, modern techniques are indispensable for supplying critical information regarding the nature and details of these tables: from establishing basic information, such as the epoch, to identifying and explaining various unidentified functions, such as a mysterious 'third function' relating to the equation of the conjunction of Mars, to suggesting numerical links as to how these tables fit into the broader computational nexus of mathematical astronomy traditions of this period. We consider the use of such quantitative techniques in this context, the conclusions they offer, and how they can contribute to the historical discourse of early second millennium astral sciences in India more generally.

Richard KREMER | Dartmouth College, United States

Using computers to crack syzygy tables: The case of Immanuel Bonfils' *Six Wings* (c. 1350)

Composed in Hebrew at Tarascon on the Rhone, the *Sepher Shesh Kenaphayim* (Book of Six Wings) presents six tables for predicting eclipses, largely based on the parameters and methods of al-Battani. This work, composed by the Rabbi Immanuel ben Jacob Bonfils, enjoyed considerable distribution and remains extant in 35 Hebrew manuscripts, 12 Greek manuscripts, and two Latin versions. Gassendi and Peiresc were even discussing the tables in the 1630s. The most complex table in the set gives the correction in time from mean to true syzygy, in a double-entry format. This table does not derive from al-Battani; its computational foundations have not been discovered. By using computerized versions of the Toledan and Alfonsine Tables, I shall show how we might search for the hidden algorithm by which Bonfils composed his syzygy table.

Matthieu HUSSON | Université Paris Diderot - Paris 7, France

Astronomical tables and the recovery of ancient mathematical practices

What happens if we look at astronomical tables not as artefact which embody such or such astronomical, cosmological or astrological theory but more crudely as the product of mathematical computations? In terms of quantitative analysis the first point of view often amount to dig out astronomical parameters from the tables, while for the second perspective the questions becomes: how numerical values of the tables were computed? This look at astronomical tables from the point of view of the history of mathematics is growing both on the "practical turn" of the history of mathematics and on the development of more and more refined quantitative techniques to analyse tables by the historians of astronomy.

This presentation will first draws from the existing literature some of these quantitative techniques developed with various aims but which may be used by the historian of mathematics to recover ancient mathematical practice from astronomical sources, before discussing some of my works in this direction mainly on the *Tabule magne* of John of Lignières and on the *Tabule permanentes* of John of Murs both made in Paris between 1320 and 1330. From these first attempts we will give provisional conclusion on the achievable aims of such studies and on their potential signification both for the history of mathematics and astronomy.

S096. The making of transnational science: scientific contacts between China and the West during the late Qing and Republican China

Sponsoring bodies:

DHST East Asia Commission

DHST Pacific Circle Commission

Wed 24 July, 09:00–12:30 ▪ Roscoe 2.4

Symposium organisers:

HAN Qi | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Danian Hu | City College of New York, United States

Symposium abstract

In recent years historians have made great strides in advancing our understanding of developments in Chinese science and technology, particularly during the late nineteenth century and in the post-1949 period. Relatively few scholars, however, have carefully explored the first half of the 20th century, especially the period between 1911 and 1949. Moreover, the concept of “Chinese science” during this period has usually been construed as scientific activities conducted by native Chinese scientists and institutions. As a result, the contributions of foreign scientists working in China and foreign institutions such as missionary universities were often excluded, if not ignored, in relevant historical studies of Chinese sciences. This uneven approach has prevented us from fully understanding the development of various Chinese scientific disciplines, especially in fields where transnational contributions were significant. Although the situation has gradually improved since the 1990s, we still have much work to do in order to fill the gaps of our knowledge.

To call attention to this under-studied field, we organize this symposium composed of three Chinese and three American historians, examining the studies of archeology, geology, mining, modern physics, and nutrition. This symposium will focus on foreign scientists and organizations, which operated for extensive periods of time in China, and on Sino-foreign scientific interactions, thereby illuminating the formation of Chinese science from both transnational and international perspectives. The symposium will be divided into two sessions. In the first session, Wu examines the mechanism of how Western railroad and mining technology arrived in China via foreign engineers. In particular, she discusses the German engineers Gustav Behaghel and Friedrich Solger, both of whom served as the first foreign faculty members in the Department of Geology at Peking University and contributed to the science of geology in China. Han studies Johan Gunnar Andersson, a Swedish geologist, who came to China in 1914, serving as a mining adviser, a fossil collector, and an archaeologist successively. He analyzes Andersson’s activities and influence both as a geologist and as an archaeologist. Sun explores Amadeus W. Grabau who worked in China for 26 years and made indispensable contributions to the development of Chinese geological science, especially in the realm of geological education, during the first half of the 20th century.

In the second session, Fu examines the career of William H. Adolph, an American biochemist whose academic career included professorships at the University of Nebraska, Cornell University, Yenching University, and the Peking Union Medical College. Adolph’s vast and varied work on nutrition helped lay the groundwork for biomedical nutritional research in China. Zhang investigates profound changes of Chinese geology during the Sino-Japanese War (1937-1945). In particular, she will examine the contributions of several European geologists active in wartime China. Hu examines William Band’s career and contributions in Republican China. Band was a young British physicist who established his career at Yenching University in Peking during the 1930s and made significant contributions to physics education and research in China. Band also worked with Joseph Needham in Chongqing to aid Chinese scientists during the war.

S096-A

Wed 24 July, 09:00–10:30 ▪ Roscoe 2.4

Chair: Danian Hu | City College of New York, United States

Shellen Xiao Wu | University of Tennessee, Knoxville, United States

Constructing science and modern empires: geology and mining engineers in China, 1880-1920

My paper examines in detail the mechanism of how Western railroad and mining technology arrived in China via foreign engineers from the late Qing into the Republican period. Empire offered German engineers trained in the leading European technical colleges the opportunity for

lucrative careers overseas. The careers of these men spanned not only continents but also British, Dutch, and German colonial holdings, as well as paid service to the Qing / Chinese government. Two of these engineers, Gustav Behaghel and Friedrich Solger, also served as the first foreign faculty members in the Department of Geology at Peking University. Their contribution to the science of geology in China was based in fieldwork and their experiences as engineers in colonial mining ventures. The careers of these engineers transcended national boundaries and reflected the political and economic conditions in the late nineteenth and early twentieth centuries. Including engineers in the narrative of science transmission in China expands our understanding of science and of the scope of late Qing efforts to modernize. Not only capital flowed internationally, but also the men who built railroads and mined for the treasures of the earth.

HAN QI | Institute for the History of Natural Science, Chinese Academy of Sciences, China

From mining adviser and fossil collector to archaeologist: Johan Gunnar Andersson (1870-1960) and his scientific activities in China

Johan Gunnar Andersson (1870-1960), a Swedish geologist, arrived in Beijing in 1914 as a mining adviser to the Chinese government. However, he was widely known in China as an archaeologist for his famous discovery of Yangshao culture. He stayed in China for more than ten years, and his career in China can be divided into three periods. First, he served as a mining adviser, and then he became a fossil collector. Finally, he did field work as an archaeologist and found many important historical sites in China. During his first years in China he played an important role in finding mineral resources and taking part in the activities of the Geological Survey of China. Based on his correspondence with European, American, and Chinese scholars, I will analyse his activities as a geologist and his contacts with Chinese geologists. In addition, I will describe how his researches were used by Chinese geologists, based on his Chinese geological work and journals such as the Bulletin of the Geological Society of China. Finally, I will discuss his archaeological work in Henan, Gansu and other regions and his influence on the study of ancient Chinese culture.

SUN Chengsheng | Chinese Academy of Sciences, China

Amadeus W Grabau and geological education in China

Amadeus W. Grabau (1870-1946) was not only a world famous geologist, paleontologist, but also took a very active part in geological education in China during the first half of the 20th century. Invited by Dr. V. K. Ting 丁文江, Grabau came to China from Columbia University in 1920 and acted concurrently as chief paleontologist of the Geological Survey of China and professor at the National Peking University. He not only devoted himself to scientific research but also trained many Chinese students with enthusiasm. The first generation of Chinese geologists and paleontologists, such as Sun Yunzhu 孙云铸, Yang Zhongjian 杨钟健, Gao Zhenxi 高振西, Zhao Yazeng 赵亚曾, Tian Qijun 田奇隼, Si Xingjian 斯行健, Huang Jiqing 黄汲清, Zhang Xiti 张席禔, Yue Senxun 乐森璿, Zhu Sen 朱森, Xu Jie 许杰, Ji

Rongsen 计荣森, were all directly influenced by him. Through his popular reports, lectures, and correspondence, he also helped promote the development of Chinese geology to the public in both China and the West. In short, Grabau made indispensable contributions to the development of Chinese geological science, which he hoped would take a place in the world. There are some studies of Grabau, but none of them has made in-depth investigation about his role in Chinese geological education. This paper will discuss Grabau’s influence on Chinese geological education during the first half of the 20th century. I will examine his works, particularly those concerning Chinese geological

and paleontological studies and investigate his role in training Chinese students and organizing geological societies based on both Chinese and Western sources, especially the primary materials at Peking University Archives and the Second Historical Archives of China as well as the memoirs of his pupils and colleagues.

S096-B

Wed 24 July, 11:00–12:30 • Roscoe 2.4

Chair: HAN Qi | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Jia-Chen Wendy Fu | Case Western Reserve University, United States

The protein problem of China: William H Adolph and biomedical nutrition in republican China

My paper examines the career of William H. Adolph, a prominent biochemist who had served as president of Yenching University before joining the department of biochemistry at the Peking Union Medical College. His vast and varied work on nutrition helped lay the groundwork for biomedical nutritional research in China. Working alongside Wu Xian of Peking Union Medical College and Hou Xiangchuan of the Henry Lester Institute of Medical Research in Shanghai, Adolph established nutritional guidelines, which they set forth under the title “Minimum Nutritional Requirement for China,” that became the basis for future investigations into Chinese dietary habits, the nutritional composition of local foods, and the physiological effects associated with different nutritional states in Republican China. On the face of it, this set of nutritional guidelines seemed to differ little from its immediate and international precedent, the League of Nation’s 1936 bulletin, “Physiological Bases of Nutrition.” The Chinese nutrition committee adopted many, but certainly not all, of the nutritional parameters set forth in the League of Nation’s study. Moreover, it is clear from the language and content that the Chinese nutrition committee shared many of the theoretical suppositions advanced by the “Physiological Bases of Nutrition.” And yet, this set of nutritional guidelines represented more than just a moment of scientific consonance among different groups of scientists. What distinguishes this first and earliest instance of national standard-making about the Chinese diet is the degree to which the physicians and scientists involved insisted upon their authority to choose the precise terms in which biomedical nutritional knowledge ought to be applied to the Chinese context. The critical issue addressed by these guidelines concerned the role of protein in the diet, and in this regard, Adolph was an important figure in the characterization of China as protein deficient. His research and popular advocacy elaborated a line of scientific argument that established the primacy of protein as arbiter of national health.

Jiuchen ZHANG | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Western geologists and Chinese geology around the second Sino-Japanese war

When the Japanese launched the full-scale invasion in China in 1937, modern geology had been founded in the country for 20 years. During the war that lasted until 1945, Chinese geology underwent profound changes. Before the war, there were in China a total of 9 geological institutes and 4 college departments of geology. During the war, the Chinese government moved its capital from Nanjing in central east China to Chongqing in the southwest of the country. Meanwhile, most of the geological institutes also moved to the west part of China, which dramatically altered the distribution of Chinese geological institutes as well as the course of the Chinese geological development. The new institutional distribution not only influenced the choices of areas for fieldwork, but also varied the contents of Chinese geological studies. Due to the urgent demand from the wartime industry, finding mineral resources became a main task of Chinese geologists. Realizing the

significant role of geology in the war, both the government and relevant enterprises promoted the development of geological survey. About 6 new geological institutes and 5 additional college geological departments were established during the wartime. They actively advanced applied geology but held up the development of theoretical geology, such as palaeontology and palaeoanthropology which had progressed quickly in China before the war. Despite the serious war-related impediments to international geological exchanges, some European geologists still came to China and so did many Chinese students who studied overseas. And these people continued to disseminate Western geological theories. The wartime was a very important period for the development of modern Chinese geology. It was during this time when most of the early Chinese geologists grew up, the main Chinese geological issues emerged, and the long-influential Chinese tradition favoring fieldwork actually formed.

Danian Hu | City College of New York, United States

A British physicist in Republican China: William Band’s contributions to Chinese science

William Band was a British theoretical physicist, who received his M.Sc. at the University of Liverpool in 1927. In 1929, he gave up a chance to study for his Ph.D. in the Cavendish Laboratory at Cambridge University as well as a lucrative job offer from the Imperial Chemical Industries; instead, he chose to accept the call from the physics department at Christian Yenching University in Peking. Three years later, Band became the head of the department which he led for the next decade until the Japanese army shut down the university in December 1941. At Yenching University, Band not only established his career as a theoretical physicist but also made significant contributions to Chinese development in modern physics education and research, cultivating many distinguished Chinese physicists in the 20th century. After Pearl Harbor, Band narrowly escaped from Japanese-occupied Peking and sought refuge in Communist guerrilla bases, where he helped train many Chinese radio technicians. Having completed his legendary 1,000-mile trek, he arrived in Chongqing in early 1944, where he worked with Joseph Needham to aid Chinese scientists and their studies in the war. Based on archival resources in both English and Chinese, I will explore in this paper Band’s motives to relocate in Peking and discuss his transnational scientific contributions which have so far been largely overlooked.

S097. From antiquity to tradition? Innovation and the past in East Asian science, technology and medicine, from the seventeenth to the twentieth century

Sponsoring body:

DHST East Asia Commission

Fri 26 July, 09:00–15:30 • Roscoe 2.2

Symposium organisers:

Jiri HUDECEK | Charles University, Czech Republic

Catherine JAMI | CNRS, France

Symposium abstract

Claims as to the “ancient” origins of knowledge were a received way of legitimating it in early modern East Asia. In the late 19th and 20th centuries, however, with the rise of nationalism, socialism and liberalism, the ‘traditional’ origins of knowledge were increasingly put forward

instead. In order to highlight the changing appeal of antiquity and tradition in science, technology and medicine in these centuries, this symposium brings together studies on the early modern period with others focusing on the 20th century that address the following questions:

How were techniques, concepts and beliefs ‘recovered’? Were they sought in ancient sources pertaining to elite traditions, or in more recent sources preserving local ‘little traditions’? With what aim was this done: retrieving a lost golden age, or constructing theories and disciplinary practices aiming to be modern and universal? In what ways did the specific forms of appeal to antiquity and tradition change? In addressing these questions, both the practice of science, technology or medicine and the discourse on it should be considered, in order to show whether and how the two are related to one another.

Our aim is to analyse the ways in which early modern scholars and then modern scientists of East Asia positioned themselves on the shoulders of their own giants, and thus to shed light on the complex nature of the transition from ‘traditional’ to ‘modern’ science.

S097-A. Antiquity and tradition before the colonial eras

Fri 26 July, 09:00–10:30 ▪ Roscoe 2.2

Chair: Jiri HUDECEK | Charles University, Czech Republic

Catherine JAMI | CNRS, France

Antiquity and empire: legitimating mathematics in early and mid-Qing China

The prefaces to Chinese mathematical works produced in the imperial period are important material for the reconstruction of the history of mathematics in China. They provided a way for their authors to situate the prefaced work with respect to earlier ones, both ancient and more recent. In fact, these prefaces give us access to representations of and attitudes to the past and present of mathematics, rather than merely to “historical facts” about it. During the seventeenth century, the introduction of “Western learning” (xixue 西學) by the Jesuits led to a recasting of the historical narrative of mathematics that integrated the knowledge imported from Europe into “Chinese learning” (zhongxue 中學). On the other hand, the Qing dynasty’s (1644-1911) appropriation of the mathematical sciences as a tool for statecraft and for territorial expansion also entailed a historical discourse on these disciplines. In this paper, I will show how these two factors contributed to shaping attitudes towards Chinese antiquity and to the mathematical knowledge it allegedly possessed. For this purpose, I will consider the two persons who most influenced the reconstruction of the mathematical sciences during the early Qing period, relying mostly —but not exclusively— on prefatory and other front matters from the works they wrote or commissioned. On the one hand, the Kangxi Emperor (r. 1662-1722), whose interest in the sciences is well known, played a major role in their reconstruction as an imperially sponsored discipline: while referring to Chinese antiquity, the narrative associated to that reconstruction emphasised the unprecedented character of the achievements made possible by his patronage. On the other hand, Mei Wending 梅文鼎 (1633-1721), the most famous mathematician and astronomer of the time, investigated ancient sources in these fields, proposing original historical interpretations for them. At the same time he claimed that men of antiquity did not possess better knowledge than his contemporaries; rather, Antiquity provided a model for the devolution of authority to specialists by rulers in the mathematical sciences. The opposition between these two standpoints, which were, to some extent, reconciled during the first decade of the eighteenth century, is in some ways reminiscent of the “Quarrel of Ancients and Moderns” as it developed mainly in France at the same time. The relevance and limits of this parallel will be discussed in the conclusion of this paper.

Jiang-Ping Jeff CHEN | St Cloud State University, United States

Explanation as an appeal to antiquity and attack on tradition in seventeenth-century Chinese mathematics

Comparison of treatises written/published in the 16th and 17th century brings to light a drastic change of writing styles in traditional Chinese mathematics. Though historians of Chinese mathematics generally agree that such transformation is in part a Chinese response to the introduction of Jesuit mathematics into China, in particular the translation and publication of the first six books off Euclid’s *Elements* as *Jihe yuanben* 幾何原本, explication of such a grand transformation is needed to better understand its impact on the development of Chinese mathematics since the beginning of the 17th century.

In this paper, we examine the role of explanation in the mathematical treatises in 17th-century China using Mei Wending’s (1633-1721) *Fangcheng lun* 方程論 as a case study. Mei broke away with the textual tradition and adopted an approach that resembles “written oral instruction.” In his effort to explain, he categorized all the *Fangcheng* problems into four kinds and applied appropriate procedures accordingly, counter to the mainstream practice of the day. Mei’s explanation appeals to *suanli* (computational principles) to justify itself as a true heir to “antiquity.” Consequently, Mei’s detailed narratives of procedures and their underlying principles not only make his texts more accessible to general readers, but also justify his approach as coming from ancient orthodoxy. Mei’s approach later became the mainstream practice either through his persuasion or through its inclusion as *the* approach to solving *Fangcheng* problems in *Shuli jingyun* (數理精蘊), the imperially produced mathematical compendium.

Chuan-hui MAU | National Hsing Hua University, Taiwan

The Chinese traditional knowledge at the mechanization of French silk industry during the eighteenth and nineteenth centuries

When we talk about the circulation of sciences and technology, the first idea appeared is mostly the introduction of European knowledge into China. In the present paper, I will focus on the introduction of Chinese knowledge into France. In the case of silk industry, I will examine how French scholars and industrialists “translated” Chinese silk know-how into French and how they assimilated the information for silk industry mechanization. As we know at the end of the 17th Century, one of the essential objectives for sending the French Jesuit mission into China was to collect Chinese knowledge and know-how for improving French silk industry which started to flourish since several decades earlier. Even though French artisans succeeded to weave figured silk fabrics, the quality was far below that of the silk imported directly from China. On the one hand, the low productivity of raw material and the poor quality presented a severe obstacle. On the other hand, the French weaving loom demanded more time for producing silk weaving goods weakened obviously the competitiveness of French silk industry. In this presentation, I will use the manufacture of silk goods as an example to examine the process in which the French collected Chinese knowledge, then analysed, and adopted it to develop their own technology. They finally succeeded in create mechanical weaving looms in order to reduce manpower and the amount of time for making silk goods.

Jia-Ming YING | Taipei Medical University, Taiwan

A Korean reading of the Jade Mirror in the nineteenth century

The *Siyuan yujian* 四元玉鑑 (Jade Mirror of Four Unknowns, 1303), written by Zhu Shijie 朱世傑 (13th – 14th c.), is a text which discusses an algebraic method with up to four unknowns, based on the procedure of the celestial element (*tianyuan shu* 天元術), the place-value notation for polynomials and equations developed in China’s Song Dynasty (960

– 1279). The procedure of the celestial element was lost in China since the middle of the 14th century, and it was rediscovered in the 18th century. This method might have been transmitted to Korea in the late 13th century, but there is no evidence to suggest that the *Siyuan yujian* was also brought to Korea before the 19th century. Unlike in China, there seems to be a continuous tradition of Korean mathematics in the practice of the procedure of the celestial element, and when the calculation by borrowed root and powers (*jiegenfang* 借根方), the cosmic algebra taught to emperor Kangxi 康熙 (r. 1662 – 1722) by Antoine Thomas, was transmitted to Korea, Korean mathematicians seemed to have learned the method based on their understanding of the procedure of the celestial element. The *Siyuan yujian* was republished in China in the early nineteenth century, but the text itself was difficult to understand. Luo Shilin 羅士琳 (1789 – 1853) provided calculation processes for each problem in his *Siyuan yujian xicao* 四元玉鑑細艸 (Detailed Calculations for the Jade Mirror of Four Unknowns), which was soon brought to Korea, and for this work the Korean mathematician Nam Pyŏng-Gil 南秉吉 (1820-1869) wrote a commentary, the *Oggam secho sanghae* 玉鑑細艸詳解 (Comprehensive Explanations of the Detailed Calculations for the Jade Mirror, 1850s). In this text, Nam provided some procedures different from those of Luo's, one of which is that he tried to avoid negative powers in order to make simpler the counting rod expressions. Another interesting piece of commentary tells that he used the idea of "equality" in the procedures of polynomial addition and root extraction, which suggests influence from the calculation by borrowed root and powers. Later in another work of his, he explains counting rod expressions with ideas of "row" and "column", and he seemed to have changed his mind on his opinions about the procedure of the celestial element and the calculation by borrowed root and powers.

S097-B. Transmission and traditions: East Asian versus Western technology and medicine

Fri 26 July, 11:00–12:30 ▪ Roscoe 2.2

Chair: Catherine JAMI | CNRS, France

C. Michele THOMPSON | Southern Connecticut State University, United States

Lymph and lancets, scabs and scalpels: crossovers between Chinese-style variolation and Jennerian vaccination

By the sixteenth century variolation to prevent smallpox was an elaborate and fairly well known medical technique in China. By the middle of the nineteenth century knowledge of this procedure had spread to several countries in East and Southeast Asia, including Japan and Vietnam. There is evidence that techniques used in Chinese style variolation shaped the practice of vaccination by indigenous vaccinators in Japan after the Dutch introduced vaccinia and the techniques associated with its use and propagation from the Dutch East Indies. Indeed, viable vaccinia was finally, after decades of failed attempts, successfully imported to Japan only after Japanese physicians familiar with Chinese style variolation suggested that the Dutch send cowpox scabs rather than lymph. Transport of smallpox scabs, containing attenuated smallpox virus, was standard practice for Chinese variolators. Conversely, there is also evidence that procedures used in vaccination, which had been introduced from Macau in 1821, shaped the practice of Chinese style variolation in Vietnam. Indeed, Vietnamese physicians practicing variolation were observed to make cuts in the skin to insert the variolus material much as cuts were made by western physicians practicing Jennerian vaccination. Using evidence from archival materials held in Ha Noi, Lisbon, Paris, and Singapore this essay will explore this cross-fertilization between traditional Chinese techniques and practices and introduced western medical procedures.

Mathias VIGOUROUX | Zhejiang University, China

Western anatomy applied to acupuncture: innovation within tradition in early nineteenth-century Japanese medicine

The publication in 1774 of Sugita Genpaku (1733-1817) epochal book *Kaitai shinsho* (New book on anatomy) that challenged Japanese traditional understanding of the human body based on Chinese medicine by introducing the importance of anatomy in the practice of medicine gave impetus to the development of Western medicine in Japan. It marked symbolically the acknowledgment as a scholarly activity the translation of Western medical books that used to be the *chasse gardée* of a handful of Nagasaki interpreters, and established Edo as the new cutting edge scholarship center for Dutch studies along with Nagasaki. The publication of the *Kaitai Shinsho* was followed indeed by an increasing number of Japanese translations of Western medical textbooks and books recording autopsies conducted in Japan under the supervision of Japanese physicians. It was in this thriving Dutch medicine learning environment that at the turn of the nineteenth century Ishizaka Sōtetsu (1770-1841) became the leader of a new generation of acupuncturists trained both in classical Chinese medicine and Dutch medicine. Western anatomy for its similarity with ancient Chinese medicine became central to Sōtetsu's task of recovering the true meaning of the Chinese classics and more particularly in helping him to identify the speculative theories and making the invisible parts of the Chinese conceptualized human body visible. Sōtetsu turned to Western anatomy for it helped him to question outside the stranglehold of the Ancient Formulas School paradigm the establishment and the standard sources that stood for tradition. Ishizaka Sōtetsu's medicine did not radically break with previous Japanese medical ideas but rather was the latest development of these academic disputes that since the late seventeenth century highlighted the symbolic struggles of Japanese physicians to reinterpret the textual tradition of Chinese medicine. Through the analysis of Sōtetsu's writings on acupuncture, I aim to shed new light on how Western anatomy gave Chinese medicine educated Japanese physicians new methodological and epistemological tools to reconstruct Chinese theories into a new theoretical framework and thus allowed them to find a place in these debates that flourished in Japanese medicine since the late seventeenth century.

Hsien-chun WANG | National Tsing Hua University, Taiwan

New terms and old ideas: changes in Chinese understanding of matter in the nineteenth century

One of the most dramatic changes in the history of modern China is its acceptance of modern science. For centuries the Chinese literati had been exploiting the power of the ideas of *Qi*, *yin-yang*, and the five phases (*wu xing*) for describing their cosmology, which did not distinguish the natural and human worlds. That set of knowledge was seriously challenged in the second half of the nineteenth century when Western powers brought not only guns and steam warships but also a much more complex system of understanding the material world. China had to accept the new knowledge because it was deeply intertwined with how guns and warships were built, and hence the survival of the empire was at stake. This study explores how the epistemological obstacles of the *Qi* theory could be broken down and new knowledge reconstructed with newly invented terms through translations, focusing on the understanding of matter. By doing so it examines the question of what constitute knowledge in Chinese culture and its changes in the late nineteenth century.

John P DiMOIA | National University of Singapore, Singapore

Complicating innovation and modernity in the Taehan moment, 1897-1910

The Great Taehan Empire (1897-1910), although once seen as the last gasp of the Choson dynasty prior to the onset of formal Japanese colonialism, has increasingly come to be seen as a far more complex

period, as the Korean court and various interest groups sought to introduce social reforms, and to appeal variously to Japanese, Chinese and Russian interests. In particular, the technical infrastructure introduced during the period (electric lighting, streetcars) has increasingly become the object of scholarly attention from those who seek to cite the moment as the origins of a “Korean” modernity, one that emerged prior to the massive Japanese techno-projects of the 1920s and 1930s.

This paper addresses this moment by looking specifically at the introduction of new technologies, focusing on their material and symbolic roles within late Choson culture, focusing on the electrification efforts associated with the Korean court. Incorporating technologies from abroad within a domestic setting, the Taehan electrification effort successfully achieved its designs with electric lighting, although at the same time, the tensions present within the project highlight the limitations of attributing an exclusively nationalist narrative to this activity.

S097-C. Antiquity, tradition and self-construction in the age of nationalism, part 1

Fri 26 July, 14:00–15:30 ▪ Roscoe 2.2

Chair: C. Michele THOMPSON | Southern Connecticut State University, United States

Roberto PADILLA | University of Toledo, United States

Asiatic cholera and modern Japanese identity: intersections between scientific medicine and the Japanese self

From the initial cholera pandemic that reached Japan in the 1820s up to the Sino-Japanese War in 1894-1895 the Japanese medical community conceptualized cholera in a number of ways that reflected both shifting understandings of the disease related to changes in medical knowledge, as well as a consistent perception that posited cholera as an outside illness. This paper offers a brief overview of the various disease classifications used to refer to cholera during the nineteenth century and focuses on the use of the term “Asiatic cholera” in Japanese medical writings in official government documents and medical journals. Prior to the 1880s Japanese practitioners of Western scientific medicine, here defined as a form of medical knowledge originating in Europe and shaped by institutions like medical schools, universities and research centers, viewed cholera within the dual framework of Asiatic cholera and kakuran. The disease category of Asiatic cholera originated in Western medical writings in the nineteenth century and referred to a deadly epidemic disease associated with Asia, while kakuran was a Japanese medical term that indicated a less pernicious enteric illness. In general Japan’s medical community used these two disease categories to differentiate between a dangerous foreign malaise and a milder Japanese illness. In 1883 German medical researcher Robert Koch demonstrated that cholera resulted from a microbial pathogen he called the cholera vibrio. His work was instrumental in laying the groundwork for Germ Theory, which was an understanding that linked the onset of a specific infectious illness to a specific microbial pathogen. The Japanese medical community’s broad embrace of Germ Theory should have brought an end to the epidemiological binary of Asiatic cholera and kakuran in favor of one disease, cholera. My research demonstrates that the continued use of Asiatic cholera in Japanese medical writings persisted, because conceptually it implied a clear distinction between Japan and the Asian continent.

BIAN He | Harvard University, United States

Rethinking “methods of antiquity”: learned discourse and artisanal practice in the local

pharmaceutical tradition of Zhangshu (Jiangxi, China)

Late imperial Chinese pharmacies often advertised their wares as manufactured “according to the methods of antiquity” (zun gu fa), whereas local practice in market towns and merchant groups differed vastly in what “methods of antiquity” stood for. During the second half of the 20th century, however, practitioners of Traditional Chinese Medicine (TCM) sought to reconstruct a standardized pharmaceutical protocol out of diverse local experiences. To what extent did the modern discourse of “traditional” pharmaceutical skills appropriate, and also divert from, the late imperial reverence towards antiquity? Furthermore, what did the discursive transition from antiquity to tradition tell us about the shifting boundaries between public and secret knowledge in Chinese medical practice? In this paper, I use the example of Zhangshu, an important medical market town located on the Gan River of Jiangxi province, as a case study in the history of pharmaceutical practice in China. Zhangshu enjoyed its heyday during the eighteenth century, when merchant groups from all over the Qing Empire traded raw medicines there in large quantities. Once a deal was made, local artisanal shops then provided services to transform raw medicines into “cooked” form ready for sale in retail pharmacies. Pharmacological texts produced during that time also reflected a confluence of learned discourse with information from the local trades. From mid-nineteenth century onwards, however, Zhangshu was devastated by repeated wars and its importance eclipsed by maritime trade based in post-Opium War treaty ports. When local authorities sought to revive Zhangshu’s fame as the “capital of medicine” during the 20th century, the embodied expertise of old pharmaceutical laborers were featured as mute symbols of tradition. Using oral histories and reports collected during the 1950s, I seek to highlight conflicting visions inherent in the effort to create a standard set of pharmaceutical procedures that were also simultaneously sanctioned by claims of loyalty to a unique local past.

Iwo AMELUNG | Goethe University Frankfurt, Germany

The role of alchemy in constructing the Chinese scientific tradition

Chemistry has become one of the most important fields of Chinese history of science. As other disciplines it is discussed in numerous articles and monographs with titles such as History of Chinese chemistry (Zhongguo huaxue shi) etc. While our understanding of the Chinese alchemical tradition has greatly increased in recent times, the question how the history of Chinese chemistry, which of course was closely related to the discourse on Chinese alchemy, remains still quite obscure. In this paper I will attempt to provide a first look on the early stages of the historiography of Chinese chemistry and alchemy. I especially will focus on the following problems: 1. How was the Chinese alchemical tradition integrated into an universal history of chemistry? 2. To what extent was this shift related to the reception of Western concepts of chemistry since the end of the 19th century? 3. How can the interaction between Western and Chinese attempts to understand the history of Chinese alchemy be characterized? 4. Who were the scholars and scientists looking into the history of Chinese alchemy? My analysis will be based on a wide range of sources, including material written within the framework of the so-called „Chinese origins of Western knowledge“ discourse (Xixue zhongyuan), early efforts of the popularization of science as well as academic articles and monographs written during the 20s and the 30s of the 20th century.

Jiri HUDECEK | Charles University, Czech Republic

Starting from antiquity: exploitation of tradition by twentieth-century Chinese mathematicians

Twentieth century Chinese mathematicians have generally sought to locate their work in the tradition of modern mathematics rather than in Chinese past. But in the relative international isolation and strongly populist ideology of the early PRC (1949-1976), some tried to link their mathematics to the work and intellectual interests of their ancestors. In

this paper, I compare two prominent representatives of this tendency, to show the shifting relative value of “tradition” and “antiquity” for situating mathematics in China. In the 1950s and 60s, Hua Loo-Keng (1910-1985), director of the Institute of Mathematics, appealed to the history of Chinese mathematics as a source of confidence for aspiring mathematical youth. In newspaper articles and popular brochures, he argued that mathematics should rightfully be a Chinese discipline. He also chose topics once treated in ancient and medieval Chinese mathematical texts as entry points into popularising but technical discussions of problems of more recent Western mathematics. The Chinese tradition of doing mathematics was invoked both for its relative antiquity and for the link to putative common ancestors, in order to legitimate current mathematical interests, and to argue that the Chinese were able to excel in modern mathematics as well. Since the 1970s, a different brand of mathematical historicism was adopted by Wu Wen-Tsun (born 1919). Wu elevated the Chinese tradition into a source of independent inspiration for the development of modern mathematics, specifically for his method of mechanised theorem proving. Wu’s use of Chinese tradition was forward-looking: instead of appealing to its antiquity or tracing mathematical talents to Chinese ancestors, as Hua did, Wu Wen-Tsun emphasised its relevance for the mathematics of the future. Apart from different personalities and inclinations of these two mathematicians, the difference also reflects the historical experience of Chinese mathematics prior to and during the Cultural Revolution. Ideologically induced research discontinuities made Wu appreciate long-term stable development, for him an aspect of tradition more important than its antiquity.

S098. Religion and natural knowledge in the encounter of East Asia with Europe, 1600-1800

Sponsoring body:

DHST East Asia Commission

Wed 24 July, 14:00–17:30 ▪ Roscoe 2.4

Symposium organisers:

Yung Sik KIM | Seoul National University, Korea, Republic of

Yunli SHI | University of Science and Technology of China, China

Symposium abstract

The first substantial cultural encounter of East Asia with the European West was initiated by the Jesuit Missionaries who endeavored to Christianize China and other East Asian nations, but the key discourse thus ignited was to a large degree grounded on natural knowledge. While the Jesuits deployed natural philosophy and sciences from Europe as the footing for preaching Christianity, increasing number of Chinese elites saw the “Western learning” as a new resource to complement their own knowledge about nature. In the new round of uprising tidemark of economic and knowledge globalization, scholarship in this classic field of the history of knowledge transmission and interaction has gained fresh energy. To shed new lights on our understanding of this grand cultural encounter within the framework of this congress, namely, “knowledge at work”, the papers in this symposium concentrate on the following topics:

The types of natural knowledge that the Jesuits deployed and their roles in supporting the Catholic missions.

The knowledge strategies adopted by Jesuit missionaries and their East Asian audience in dealing with the relationship between religion and

natural knowledge, and their impacts on the transmission and reception of the “Western learning” in East Asia.

The approaches of the Jesuits and East Asian literati in dealing with the foreign and the native, the old and the new in this grand trans-cultural knowledge discourse.

The dynamics, channels and consequential responses of the secondary transmission of the “Western learning” from China to its neighboring country Korea.

S098-A

Wed 24 July, 14:00–15:30 ▪ Roscoe 2.4

Chair: Yung Sik KIM | Seoul National University, Korea, Republic of

Yunli SHI | University of Science and Technology of China, China

Optical toys as an aid for preaching Christianity in the Qing Empire: missionaries and the early dissemination of European optics in China

Talking about the media for the first bout of large scale transmission of European science and technology to China before the Opium War in 1840, it is very easy for us to overlook the role played by objects other than books, objects such as clocks, musical organs, medicine, and scientific instruments. These objects are no less bearers of knowledge than books, not just in terms of the technical know-how for their making and using, but also concerning the underlying principles and theories tacitly embedded in their structures and functions, just as a slide rule embodies the rules of logarithm, while an orrery represents a geocentric or heliocentric cosmology. In this paper, I will present a special category of objects, i.e. a line of optical toys, or “instruments for recreation” and “philosophical toys” as were called by people in modern Europe. They were deployed by Jesuit missionaries in various occasions from the palace to churches mostly as exotic wonders to show the superiority of European science and arts and thus to prove the soundness and credibility of European religion. In the eyes of ordinary Chinese literati and public, these objects were exotic and wonderful enough to become subjects of literary writings as well as playthings for festival ceremonies and entertainments. In the hands of Chinese artisans and mathematicians, however, the “object-borne knowledge” in these “western wonders” was more attractive and intriguing. Not only did the knowledge be abstracted, copied and adapted to the local context of commodity production and consumption, but it was also mixed with the “text-borne knowledge” and began an interesting process of knowledge fermentation which led directly to the birth of a special system of optics totally different from what had been established by modern opticians in Europe. This paper will trace how the role of the same category of objects changed in different socio-cultural contexts.

ZHU Haohao | University of Science and Technology of China, China

Calculating the fate of Chinese dynasties with the European horoscope: a preliminary study of two astrological works by Xue Fengzuo 薛凤祚 (1600-1680)

China has a long history of its own portent astrology that was almost exclusively practised by royal astronomers and centered on the fate of the emperor, high officials and the whole country, but this did not prevent it from absorbing astrological knowledge from outside, as can be seen from the reception of Indian and Arabic astrology in the Tang (618-907) and Ming (1368-1644) dynasties. In the 17th century, Jesuit missionaries also introduced European astrology into China as a supplement to their astronomical work in this country. In 1652 and 1653, the Chinese astronomer Xue Fengzuo (1600-1680) became disciple of the Polish

Jesuit Nikolaus Smogulecki (穆尼閣, 1611-1656) and they translated Girolamo Cardano's commentaries on the *Tetrabiblos*. On the basis of the horoscopic astrology that he learnt from his Polish master, Xue composed a series of astrological essays, among which we can still read the "Tumu xianghui" (土木相会, The Conjunction of Saturn and Jupiter) and "Yuzhou dayun" (宇宙大运, The Grand Fortune-Cycle of the Cosmos). This paper provides a preliminary analysis of both the works. I will show how a Chinese astronomer calculated the fate of all Chinese dynasties with European astrology.

LIM Jongtae | Seoul National University, Korea, Republic of

The Sino-Korean network of cultural exchange and the rise of Western learning in eighteenth-century Korea

This paper examines the "Western learning" in eighteenth-century Korea as a cultural outcome of the informal network of people established between Qing China and Chosŏn Korea as a by-product of the Korean "tributary" travels to the Qing court. This network, consisting of a diverse group of people such as European Jesuits, Qing officials, Korean literati envoys, and professional interpreters and astronomers from both the Chinese and Korean sides, functioned as the main route for transactions of ideas and artifacts. European science and Christianity were among items brought into Korea through this network. Examining travel documents of eighteenth-century Korea, this paper outlines the composition and functioning of the network, and then examines how they shaped the features of "Western learning" in Korea, particularly its general emphasis upon the "material" aspects of the Western learning.

Guangchao WANG | Institute for the History of Natural Sciences, Chinese Academy of Sciences, China

The impact of western astronomy on annual almanacs during the late Ming and early Qing period, and in particular the computation of the sun's apparent entry to the twelve signs of the zodiac

This article studies the impact of Western astronomy on annual Almanacs during the late Ming and early Qing in terms of investigating the computation and its accuracy of the time that apparent sun enters one of the twelve stations of the zodiac recorded in the annual almanacs during the early and middle Qing period. Different with the traditional method of using linear interpolation to compute the solar position, the new method was a deductive geometrical system. In the new system, the solar theory has the form of a geometrical model, the parameters of which are deduced from observations. The practical computations and predictions of the solar position can be made from solar handy tables which were derived from the solar model. The data of the time of apparent sun enters one of the twelve signs in early Qing annual civil calendar were computed from Xiyang Xinfu Lishu 西洋新法历书 (Western Treatises on Calendrical Astronomy According to the New Method) in which the solar model is eccentric. The error of the data record in early Qing period remained large in general with respect to the data based on the computation by using Sky-map software. As the accuracy of computation of solar position did not increase that it attracted attention of Kangxi emperor, the emperor at last determined to open the Hall of Cultivation (Mengyangzhai, 蒙养斋) to compile Yuzhi Lixiang Kaocheng 御制历象考成 (Thorough Investigation of Calendrical Astronomy Imperially Composed). The scholar-officials in the studio constructed a double epicycle solar model which were put into Yuzhi Lixiang Kaocheng on the basis of their own observations by using the gnomon to measure and calculate the solar shadow. The data recorded in the annual civil calendar from the fourth year of Yongzheng reign period were computed according to Yuzhi Lixiang Kaocheng. But as their observations remains an error, the accuracy of the practical

computations that the time of apparent sun enters one of the twelve stations in civil calendar in which based upon the solar model did not improve with respect to the former calendar.

S098-B

Wed 24 July, 16:00–17:30 ▪ Roscoe 2.4

Chair: Yunli SHI | University of Science and Technology of China, China

Yung Sik KIM | Seoul National University, Korea, Republic of

Complementing Chinese tradition with Western science: the 'scientific burulun' and Xu Guangqi's slogan

In the first several decades of their encounter, the Jesuits and the Chinese Confucian scholars turned to ancient China and found ideas similar to those of Christianity. Such similarities led them to see congruences between Chinese (Confucian) and the Western (Christian) traditions. Many Confucian scholars resorted to the strategy of the so-called "burulun 補儒論", to complement Confucianism with Christianity. The Jesuits and Confucian scholars also came up with many examples of similarity between Western scientific ideas and those in ancient Chinese texts. In this atmosphere there arose among Chinese scholars a strong syncretic movement concerning Western scientific knowledge. In a spirit parallel to the "burulun", many Chinese scholars sought to complement the Chinese scientific tradition with Western science. They tried to put the Western scientific ideas in the framework of their own system. This paper will discuss this syncretic movement, giving particular attention to Xu Guangqi's famous remark, "Melt the materials of that side, and incorporate them into the mould of the [Chinese] Datong [calendar] (鎔彼方之材質, 入大統之型模)," which was frequently noted, and commented upon, by those engaged in the movement.

Liang Li | Insitute for History of Natural Sciences, Chinese Academy of Sciences, China

Book purgation and the credibility of Jesuit astronomy in China: an important eclipse deliberately deleted from the Chongzhen lishu (崇禎曆書)

During the astronomical reform of the Chongzhen reign, there was an important eclipse with large magnitude on March 29th in the year 1634, which provided a good opportunity to test the precision of different systems of astronomy involved in competition at the time. From a more original version of the *Gujin jiaoshi kao* (古今交食考), a part of the *Chongzhen lishu* (崇禎曆書) presently preserved in the Kyujanggak (奎章閣) archives in Korea, we discovered that the prediction of this eclipse made by the Jesuit astronomers was much more inaccurate than both the official *Datong li* (大統曆) and the system proposed by Wei Wenkui (魏文魁), one of the most stubborn adversaries of Western astronomy. However, discussion of the eclipse was eventually purged from all later versions of the *Chongzhen lishu*, apparently as way to conceal a bad failure of Western astronomy. Similar deletions can also be found in other part of the later editions of the *Chongzhen Lishu*. These deletions shed new light on the issue why the Ming government was so reluctant to adopt the *Chongzhen lishu* as the official system of astronomy. Meanwhile, they also show how Jesuit missionaries tried to defend the credibility of Western astronomy through the purgation of the *Chongzhen lishu*.

CHU Longfei | University of Science and Technology of China, China

The theory of solar motions in the first Jesuit system of calendrical astronomy in China

In the late Ming Dynasty, European astronomy was first systematically introduced into China through Jesuit missionaries, culminating in the compilation of the *Chongzhen lishu* (崇禎曆書, Chongzhen Reign Treatises on Calendrical Astronomy), wherein a system of calendrical astronomy was built up on the basis of the works by European astronomers from Ptolemy to Copernicus, Tycho and even Kepler. Since solar motion is very important in a system of calendrical astronomy, it underwent continuous revisions from the *Chongzhen lishu* to its two later re-editions, *Xiyang xinfa lishu* (西洋新法曆書, Treatises on Calendrical Astronomy According to New Methods from the West) and *Lixiang kaocheng* (曆象考成, Thorough Investigation of Calendrical Astronomy). This paper first analyses the overall differences of the three versions of the solar theory, and then concentrates on the solar models used in the whole series and explores their rationalities. Finally, the paper examines the change of the basic parameters in the solar theory and their effects on the accuracy, and analyzes the accuracy of the three versions of solar theory. Our results indicate that although the continuous revisions made the solar theory more coherent, they contributed little to the improvement of the actual accuracy of the theory itself. On the other hand, however, they reflect the Jesuit efforts in making the system more perfect to ensure its superiority over the rivaling Chinese and Islamic systems.

S099. History of metrology: a view of comparison between the West and the East

Sponsoring body:

DHST East Asia Commission

Mon 22 July, 11:00–17:30 ▪ Roscoe 2.2

Symposium organisers:

GUAN Zeng-jian | Shanghai Jiao Tong University, China

Eiju MATSUMOTO | Society of Historical Metrology, Japan, Japan

Symposium abstract

In this symposium, we would like to organize a platform for scholars all over the world to exchange their ideas and progress about the study of history of metrology. As we know, metrology played an important role in the history of mankind, especially in the process of science development and the manufacturing industry, as well as the making of measuring instruments. Today there are many scholars who are interested in the field of the history of metrology and have made deep studies in the field. For example, researches of metrological standards including length, volume, and weight have obtained great achievements so far. And now lots of works have been involved for the development of not only classic standards, but quantum standards. These developed standards contributed for creating new technology also gave good basis for people in different countries to communicate and establish good relations each other.

In this symposium, besides the traditional field of metrological history, we would like to include astronomical apparatus, land surveying technology, electrical measurement which helps the development of other technological instruments.

We organized a similar session in the 23rd International Congress of History of Science and Technology held in Budapest 2009. We had 8 presentations from China, Germany, and Japan in the session and we published a special Bulletin of Society of Historical Metrology, Japan

after the congress. We are sure that the Symposium in Manchester will pull the attendees' interests in the Congress.

S099-A. Ancient metrology

Mon 22 July, 11:00–12:30 ▪ Roscoe 2.2

Chair: Eiju MATSUMOTO | Society of Historical Metrology, Japan, Japan

GUAN Zeng-jian | Shanghai Jiao Tong University, China

On the achievements and defects of Liu Xin's metrology theory

On the Achievements and Defects of Liu Xin's Metrology Theory

GUAN Zeng-jian

School for History and Culture of Science, Shanghai Jiao Tong University

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Liu Xin (刘歆) is a famous scientist in the history of Chinese science. In the Yuanshi (元始) years (A. D. 1~5) of West Han (西汉) Dynasty, he accepted Wang Mang's appointment to organize a large-scaled reform of metrological systems then. One of the results of the reform was the formation of systematic theory of metrology. The theory had become the guidance of metrology of succeed dynasties since then. The other result of the reform was that under the guidance of Liu Xin's metrology theory, a passel of standard apparatus of weights and measures have been designed and manufactured, which became models for later dynasties to produce their own standard apparatus of weights and measures.

Liu Xin's theory of metrology developed on the basis of his understanding of numeral and temperament. About the cognition of numeral, he gave a definition of number at first and then described its social function and the relation between it and metrology. His ideas were clear and valuable to the development of metrology. But his further explanation of the function of figure leads his theory into digital mysticism at last.

Liu Xin's theory of temperament is rich in contents. He described the social function of music and discussed the basic elements of music. He illustrated the connotation of 5 sounds, 8 voices and 12 temperaments as well as their relations to all nature things and social affairs. He explained his understanding of how temperaments coming from and what is the way of their formation. However, in order to make the way looks in uniform, he gave up the demand of temperament's own quality, which caused a mistake in his theory of 12 temperaments producing each other.

The core of Liu Xin's metrology theory is the theory of "uniting length, capacity and weight on the basis of temperaments by means of broomcorn millet(乐律累黍说)". Such a theory established a kind of inner link between temperaments and metrology, which lead to a formal unity of the holiness of music and the preciseness of metrology at last. It also made the unification of length, measures, weight and temperaments became true in form. Therefore it at last became the most authoritative theory of metrology in the history of ancient China. However, the key of the theory that the length of Huangzhong tube is 9 Cun(寸) may cause mistakes in practice because that when a tube is used for standard pitch apparatus, it is necessary to make some amendment of the tube mouth, but Liu Xin's theory did not refer to it at all.

In a word, Liu Xin's metrology theory is very important in the history of Chinese metrology, it played a guiding rule to the development of ancient Chinese metrology. However, there were still some defects in his theories, which are seldom recognized by people today.

Dong YUYU | Shanghai Jiao Tong University, China

A study of how the government managed metrology activities in the northern Song dynasty, based on the Tiansheng Statutes

Metrology is the knowledge and technical instrument connected with the national economy and the people's livelihood. In ancient China, abundant practices of management and technology about metrology were accumulated. The Song Dynasty's metrology plays an important part in historical development of Chinese metrology. As a statute preserved, Tiansheng Statutes(天圣令) found in Ningbo Tianyi Pavilion (天一阁) contained important information that was reflective of the political, economic, social and cultural changes from the Tang Dynasty to the Song Dynasty. The paper gives a study of how the Government managing the Metrology Activities in the Northern Song Dynasty Based on the Tiansheng Statutes. Through the research of management in the Tiansheng Statutes about weights and measures, time metrology, space metrology, and so on, the author thinks that one hand the Northern Song Dynasty established its system of weights and measures in accordance with the Tang Dynasty's tradition, on the other hand, the Government made innovation in management and technology of metrology. Some measures have a significant impact on the development of Chinese metrology.

MA Weihua | Zhengzhou University, China

How the ninety-six units of chronometry were established in China

There were two different chronometry systems in ancient China. One was the 12-earth-chronometry, which divided one day into twelve equal parts, called Shichen in Chinese. The other was the 100 units of chronometry, which divided one day into 100 equal parts. The unit was Ke in Chinese term, originally meant the notch of the arrow in a clepsydra. The Chinese people began to combine these two systems together from Sui and Tang Dynasty (7th century). However, because one hundred and twelve were not commensurable with integral number, so they used a very complicated way to combine the two systems. In the late Ming Dynasty (17th century), when Jesuits came to China and took part in the Chongzhen Calendar Reform, they began to use the 96 units in calculation. The New Western Calendar, which adopted the 96 units of chronometry, was promulgated by government in the Qing dynasty. Adam Schall said that the 96 units were more convenient for calculation. However, a man named Yang Guangxian accused Adam Schall and the New Western Calendar in 1664. The 96 units of chronometry were also targeted, Yang Guangxian supposed that the 96 units made one day shorter than the 100 units. At that time, the political circumstance was unfavorable to Adam Schall, the 96 units were supposed to be a mistake of the Western Calendar, so the 100 units replaced the 96 units again. Ferdinand Verbiest defeated Yang Guangxian in the test of moon's orbit, etc. in 1669, which demonstrated that the Western calendar was better than Chinese calendar. Verbiest refuted Yuangxian's charge that the 4 units were the superabundance of the 100 units of chronometry, not the less of 96 units. Moreover, The 96 units did not make one day shorter. Then the Western Calendar and the 96 units were finally established in China. After that the hour, minute, second system was also established in China. However, the later Chinese scholars didn't acknowledge that the 96 units of chronometry came from western in the thought of "the theory of western learning being of Chinese origin". To sum up, the Jesuits took accommodation policy to adapt Chinese tradition in the field of chronometry. And the 96 units of chronometry had the same fate with the Western Calendar. Moreover, the debate between 100 units of chronometry and 96 units of chronometry came from the different metrological system adopted by Chinese calendar and Western Calendar.

S099-B. Metrology and standardization

Mon 22 July, 14:00–15:30 • Roscoe 2.2

Chair: GUAN Zeng-jian | Shanghai Jiao Tong University, China

Eiju MATSUMOTO | Society of Historical Metrology, Japan, Japan

The history of the Society of Historical Metrology, Japan

"The Society of Historical Metrology, Japan" was established in 1979. Membership is currently 160 people. Members have diverse experiences including Researchers from former National Research Laboratory of Metrology, Japan Association for Metrology Promotion, Certified Measurers, Collectors of Weighing and Measuring Equipment, and Researchers of History of Science and History of Technology.

The valuable members of this society are able to cover not only the classic historical study of a measuring equipment but also the history of measurement standards. The Society publishes "Bulletin of the Society of Historical Metrology, Japan" for researchers once a year, and issues "Communications in Historical Metrology" three times a year. Today, the researcher's interests cover from the beginning of the metrology of BC to the present day. For example, one of the members from the founding the society, Shigeo Iwata's study is "The origin of metrology as the civilizations" (a few thousand years ago) and the recent research, Eiju Matsumoto presents "History of reading scales which is common to the measuring instruments of analog-to-digital".

The "Bulletin of the Society" employed 250 research papers since 1979, 22 papers focused to Western countries, and 49 were targeted to Asian countries. In other words, 28% of the Society's research work contributed to foreign countries out of Japan.

In addition to the study of literature centered, the society began "Oral Interview" in 2010. It is intended to get particular knowledge or experiences from skilled persons related to the Metrology. Listening to real-life experiences of Metrological development which was not available from literatures, it is useful to fill the missing history or work.

In this session, the Society of Historical Metrology presents three papers. 1st is the research of the Society itself, the second is History of length measures, the third is Japanese unique flowmeter development". Matsumoto presents "History of Society of Historical Metrology", such as the trends of the paper employed in the Bulletin including, "The origin of metrology as the civilizations" and "Comparison of precise sale reading of the East and the West" including the application to the microbalance of Joseph Black in the 17th century.

Kenji YAMADA | Independent scholar, Japan

The origin of the introduction of the metric system in Japan

As Japan was an isolation state in Edo era which was from 1600 to 1868, especially from 1639 to 1853, it was impossible to establish western-like modernization in this era. However, Japan uniquely, formed two-way ties with Netherlands through the Dejima trading house in Nagasaki. The house was built on the reclaimed island.

Consequently, Japan had cultural interrelations between western countries through Dutch as an only window to the west in the late Edo era. Japan was able to receive the modern science, particularly in the fields of astronomy, chemistry and physical sciences, technology, and industry, which were brought to western countries after the Industrial Revolution.

On the other hand, it was difficult for Japan to receive those modern sciences because there were no stipulations on Weights and Measures of counterpart countries, especially between Japan and the Dutch.

This paper aims at revealing how Japan learned the new metric system of Weights and Measures from Dutch, and who introduced this system through books which were given from Dutch by ascertaining the Koan

OGATA's (1810-63) Introductory Notes in "Enseikatameibutkou-ho" by Sinsai UDAGAWA(1769-1834). OGATA was a scholar of Dutch learning called *Rangakusha*, and a doctor who studied the Netherlands medicine.

WANG Xiao | Shanghai Jiao Tong University, China

An infometric assessment of the scale of China's publishing industry with the evolution of a standard system, 1949-2010

Introduction:

In order to measuring a country's media in scale, evaluating the scales of different media and different historical periods, a unified information metrological standard is required as a basis for evaluation. This article sketched out the historical evolution of standard system of publishing industry in China, focused the same metrological units, and provides a quantitative basis for history research of China's publishing industry.

Method:

In national standards and legal regulations, the metrological units are International Standard Book Number (ISBN), International Standard Serial Numbering (ISSN), and International Standard Recording Code (ISRC). After the recommended standards cited into regulations, it has the administrative binding, which endows these serial numbers with mandatory, and the amount of all publishing products could be able to control in plan.

From *China's Publishing Yearbook* and *China's News and Publishing Statistical Compilations* we gather statistics data. Through calculating books, newspapers, periodicals, Audio & Video products, and electronic publications total varieties numbers, total copies numbers, and total printed sheet numbers, seeking out the average printed sheet number of single variety, we can estimates out accumulated print sheet amount of China. This printed sheet amount can be converted into layout words, and unified transformed into byte number. At last the total amount of information generated by the various published forms could be roughly estimated.

Conclusions:

In the period 1949-2010, there were cumulative 2765097 kinds of published books, the amount of layout characters is 8.162×10^{11} bytes; in the same way, the amount of periodicals is 4.98×10^{11} bytes, the amount of newspaper is 2.16×10^{12} bytes.

1991-2010, there were cumulative 401536 types of audio & video CD published, in accordance with the 650M per CD conversion rate, the total volume is 2.61×10^{14} bytes.

1996-2010, there were cumulative 150663 species of electronic publishing production; total capacity is 9.7931×10^{13} bytes.

Integrated calculation of the above published forms, in the period 1949-2010, the total amount media publication in China is about 3.6240×10^{14} bytes (330T).

With the rapid development of network publishing and digital publishing and absence of national standards in government management, how to measure the information scale becomes a new problem.

S099-C. The modernization of metrology

Mon 22 July, 16:00–17:30 ▪ Roscoe 2.2

Chair: GUAN Zeng-jian | Shanghai Jiao Tong University, China

Yilin SUN | Shanghai Jiao Tong University, China

Attempts to unify standards and metrology during the Republican Period in China

In the early Republican period, the national standards and metrology was in an unprecedented mess, which was mainly caused by two following reasons. For one thing, there was no absolute rule for standards and metrology. The government had been failing to unify the standards and metrology since late Qing Dynasty. For another, there were lots of standards and metrology using by other countries, which had been forcedly entering into China because of the gradually open customs and various unequal treaties.

The most important reforms of standards and metrology during Republican period were two metric system leading ones. The first one was AB Plan Blend launched by Warlord Government. It used A Plan (metric system) as direction and considered B Plan (yingzao-kuping units system) as a transition and auxiliary, valuing not only the international integration but also the tradition. However it failed because of political instability and ineffective implement. The second time was the plan suggested by Nanjing Government, using metric system as standards, and Chinese system as auxiliary. This suggestion built on the first one and decided a reasonable and simple conversion rate, "one two three", between one and the other. Since this time there were effective and well-planned arrangement, the second standards and metrology movements successfully eliminated the Standards and Metrology confusion in the early Republican period and established a good foundation of transferring from Chinese system to metric one.

Qingqiao HUANG | Shanghai Jiao Tong University, China

GUAN Zeng-jian | Shanghai Jiao Tong University, China

1959年：新中国计量制度走向统一

摘

要：统一的计量制度是现代国家政权统一、政令畅通的标志。多制并存的制度遗产，既是新中国计量制度一时无法统一的障碍，又是新政权能够得以缓冲并借此管理国家事务的制度基础。建国后形成的“各自为政”的计量管理体制，是计量制度一时不能统一的体制性根源。1959年，实现了计量制度和法令在国家层面的统一，但受传统习惯等因素影响，计量制度的贯彻实施，还有一个漫长过程。1959年计量制度的统一，为我们理解新中国诸多制度的起源提供了生动的注解。

关键词：1959年；计量制度；多制并存；计量管理体制；度量衡；制度起源

The year of 1959: the new China advance towards standardization of the Institution of Metrology

The institution of the standardized metrology is the symbol of the unified modern state regime and unimpeded government decrees. It was not until in 1959 that the New China came to reach the standardization of the institution of the state metrology. The institution legacy of the coexistence of various systems is the obstacle of the standardization of the institution of the state's metrology as well as the institutional foundation on the fact that the new regime was left room for maneuver and dealt with the state affairs. Apart from this, the managing system featuring with "each does things in his own way" is the systematic root of being unable to reach the standardization of the institution of the state's metrology. In 1959, the state realized the unity of the institution of metrology and its laws and regulations in terms of the whole state. However, influenced by some customs and traditions and other factors, there is still a long way to go for the implementation of the institution of metrology, the standardization of the institution of metrology in the year of

1959 offers us a vivid embodiment to understand the origin of various systems of the New China.

REN Jie | Shanghai Jiao Tong University, China

A study on the evolution of standard time in China during the late Qing and ROC period

China standard time was implemented first by foreigners who served Qing government in Aug. 1904. In 1910s, Gao Lu made a great effort to advocate standard time in China. After the popularization of radio, standard time was gradually executed, such as Guangxi province in 1933, Ministries of Communications and Railways in 1935, Chongqing Government in 1939. The evolution of China standard time was motivated by foreign force and the popularization of astronomy.

Rina SA | Shanghai Jiao Tong University, China

A comparison between the spread of Euclidean geometry in the late Qing dynasty and Meiji era

In this paper, the author compares the similarities and differences of understanding and accepting the western geometry during the transformation of the two eastern countries from traditional mathematics model to western one. Firstly, it starts with the detailed introduction of Euclidean geometry spreading to Late Qing Dynasty and Meiji Era. Secondly, it compares the translators for the Chinese and Japanese versions and discusses the background when the Euclidean geometry introduced into the two countries. Thirdly, here comes the comparison between the relations of the source books introduced into China and Japan and the analysis of their impact on the West, finding out the reasons why the translators chose the source books in China and Japan. Finally, this paper ends with the discussion of the concrete influence of the Chinese and Japanese versions in spreading the western geometry and the transformation from traditional mathematics model to western one.

S100. Comparative perspectives on ancient astronomy: the Chinese and Greek traditions

Sponsoring body:

DHST East Asia Commission

Tue 23 July, 11:00–15:30 • Roscoe 2.2

Symposium organisers:

Efthymios NICOLAIDIS | National Hellenic Research Foundation, Greece

SUN Xiaochun | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Symposium abstract

This symposium will focus on the comparison between the Greek and the Chinese traditions of ancient astronomy. Ancient astronomy basically consisted of observations of the celestial phenomena and the mathematical techniques applied to compute celestial motions. The Greek astronomy arose from Babylonian antecedents and was developed into a tradition characteristic of geometrical models, culminating in Ptolemy's almagest. The Chinese might independently developed an arithmetical tradition of astronomical computation. The two traditions had encountered through various ways in pre-modern times, but still maintained their own characters. Both traditions had their own assumptions on cosmology, ways of observations, and systems of mathematical techniques. The comparative perspectives on cosmos, measurement, and computation in the two astronomical traditions will not

only deepen our understanding of both, but also throw light on transmission of astronomical knowledge in ancient world.

S100-A. Chinese calendar-making

Tue 23 July, 11:00–12:30 • Roscoe 2.2

Chair: Efthymios NICOLAIDIS | National Hellenic Research Foundation, Greece

Anjing QU | Northwest University, China

Numerical systems versus geometrical systems

In Chinese mathematics or mathematical astronomy, when people dealt with a complex problem, a numerical system was often constructed. In this talk, I will take a few examples to show how these numerical systems work.

SUN Xiaochun | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Why didn't Northern Song China produce a Kepler?

In the beginning of the 17th century, Johannes Kepler (1571 -1630), using observations made by Tycho Brahe (1546-1601), waged his war on Mars. He won his war with the discovery of the three laws of planetary motion, bringing about a revolutionary change in astronomy, harbingering celestial mechanics of Isaac Newton.

More than five centuries earlier, in the 11th century China, in the Northern Song dynasty, there was a polymath elite official Shen Kua (1031-1095) who, realizing the serious discrepancies in the prediction of planetary movements, proposed a project to tackle the problem. Shen Kua's project, however, ended in abortion. He could not achieve anything remarkable on the computation of planetary motion. The eleven century Northern Song China, so to speak, did not produce a Kepler.

I deliberately ask this unhistorical question to raise to awareness the fact that, in terms of accuracy of the calculation of planetary motion, China in the eleventh century had already reached the similar level of the West in the sixteenth century. The Chinese had also realized problems in the prediction of planetary motion, and set to work on it. This failure to make any recognizable progress as similar to that of Kepler is something worth to be studied. We will find out many factors, technical and social, that had inhibited the development of planetary astronomy in China, thus gain fuller insight into ancient Chinese astronomy.

Fan YANG | Institute for the History of Natural Science, Chinese Academy of Sciences, China

The calculation of the motion of Mars in an ancient Chinese calendar

The calculation of planetary motions constituted a major part of ancient Chinese mathematical astronomy. The "calendar", which was essentially a mathematical astronomical system, and included methods for the calculation of the planetary motions. Mars, was the most difficult planet to predict its movements, hence its Chinese name *yinghuo* (literally: puzzling luminary). The first existent calendar, the Three Concordance System, gives detailed descriptions of syzygies of the five planets. For Mars the syzygy is divided into six phases: Direct motion immediately after appearance before dawn, First Station, Retrogradation, Second Station, Second Direct Motion, and Invisible Direct Motion. As time went on, later astronomical systems gave more and more sophisticated descriptions of the Martian motion. This paper will

investigate the descriptions about Martian motion in ancient Chinese mathematical astronomy from 1st century BC to 6th century AD, focusing on five calendars: the *Three Concordance (Santong) Calendar* (7 BC), the *Quarter-Day (Sifen) Calendar* (85 AD), the *Happy Epoch (Yuanjia) Calendar* (443 AD), the *Great Brightness (Daming) Calendar* (463 AD), and the *Imperial Principle (Huangji) Calendar* (604 AD). We

will see improvements on the computation of Martian motion as the Chinese made progress in the understanding of the planetary motions. In particular, the unevenness of solar and planetary motions was taken into consideration in the *Imperial Principle Calendar*.

The Chinese approached the planetary calculation with numerical methods, which contrasts interestingly with the Greek geometrical methods.

Li Geng | National Astronomical Observatories, Chinese Academy of Sciences, China

Gnomon shadow measurement in ancient China: a prehistoric case

Measuring the length of gnomon shadow was one of the fundamental astronomical observations in ancient China. It could help determine the seasons and orientation. Thus it was crucial for calendar making, which constituted an important aspect of imperial governance. This paper focuses on origin and development of gnomon shadow measurement, discusses the usage of a discovered painted stick four thousand years ago as the oldest gnomon, and shows the astronomical and social importance of gnomon shadow measurement through analyzing its role in the transition of cosmological theories, in the establishment of imperial government, and in the calendar reforms in ancient China.

Computational analysis shows that the gnomon shadow lengths for the Winter and Summer Solstices recorded in the Zhou bi suan jing might have originally been measured at the Prehistoric (ca. 4300 BP) astronomical site of Taosi in Linfen, Shanxi. In 2002, a painted stick with calibrated scales was excavated in a royal Tomb from the Taosi culture. As we restored the stick and made a series of computational analysis and simulate measurements, we found the yearly-dates corresponding to the red-belted marks on the stick fit well with the yearly-dates obtained from the "horizontal calendar" of the Taosi site. According to our analysis, the painted stick should be about 173 cm long. By opening the two halves of the stick, the length of the stick is doubled, serving as the template of the gnomon of 8 chi (200 cm) long. Gnomon shadow measurement, as a replacement for the "horizontal calendar", reflected the development of civilization from local to universal. Moreover, gnomon shadow lengths for the twenty-four solar terms from the BC 200 to AD 900 figures that these data featured two types, which might have signified the transition in cosmological theory from "covering sky" to "celestial sphere" as two separate academic traditions. Gnomon shadow measurement was of top priority for the rulers to establish imperial authority government during Zhou dynasty. As mentioned in the Zhou li, the capital should be constructed at the "center of land", where the gnomon shadow length on Summer Solstice measured 1.5 Chinese Chi (approximately 37.5cm). The "center of land" symbolized where the imperial authority lied. Boundaries of territories of vassalage were also determined by the gnomon shadow length. This was based on the shadow principle "one shadow length Cun corresponds with one thousand Li on earth".

Commentary: Christopher CULLEN | Needham Research Institute, United Kingdom

S100-B. Greek tradition in various cultures

Tue 23 July, 14:00–15:30 ▪ Roscoe 2.2

Chair: SUN Xiaochun | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Flora VAFAE | Abet Greek School, Cairo, Egypt

The Greek tradition as traced in the treatise of Severus Sebokht on the astrolabe

Among the earliest surviving treatises on the astrolabe, the treatise of Severus Sebokht (7th c. AD), written in Syriac, is included. This treatise

was edited and translated into French in 1899 by M.F. Nau.

The first part of the treatise contains a description of the astrolabe, while the second part explains the use of the astrolabe in 25 chapters. The terminology used is the Greek one; the Greek terms are written in Syriac characters, but some terms are not used in the proper way.

Some chapters are similar to the respective ones of the treatise of Ioannes Philoponus on the astrolabe (6th c. AD), but Severus Sebokht includes chapters on additional subjects.

Ya'qūbī (9th c. AD) ascribes to Ptolemy a treatise on the plane astrolabe and preserves its table of contents. Neugebauer, in *The Early History of the Astrolabe* (ISIS 40, 1949), comparing the table of contents preserved by Ya'qūbī to the treatise of Severus Sebokht, claims that "Sebokht has preserved a work of either Ptolemy or Theon", supposing that perhaps Ya'qūbī had replaced the name of Theon with that of Ptolemy.

The study of Sebokht's treatise reveals at least two different sources. The first part contains two incompatible descriptions of the disks of the astrolabe: the rim of the disk coincides with the Tropic of Capricorn or with the greatest of the circles of perpetual occultation; the former appears in the treatise of Philoponus, while the latter is mentioned by Synesius (4th-5th c. AD).

Sebokht mentions Ptolemy and the Philosopher who constructed the astrolabe as two different persons and uses their results. In the last chapter of the treatise, we may also find traces of the *Introduction to phaenomena* of Geminus.

Although Sebokht's treatise deals with some subjects not discussed in the treatise of Philoponus, the only complete surviving treatise on the astrolabe before Sebokht, it ranks at a lower scientific level because of the numerous errors that appear in it.

Eun Hee LEE | Yonsei University Observatory, Korea, Republic of

Islamic influence on Korean astronomy and astronomical instruments in the fifteenth century

From the 13th century, Islamic culture began to be transmitted to Korea through the Mongol 蒙古 and Yuan 元 China, which governed Koryo 高麗 (918-1392) during the almost 100 years. Obviously, however, Islamic science and technology were deeply assimilated in the King Sejong period (1418-1450) of Joseon 朝鮮 (1392-1910), when a grand project for the calendar and instrument making was proceed. During this time, lots of astronomical and calendrical books including Islamic sources of Chinese version were imported from Ming 明 China, and researched by the court astronomers of Joseon. Moreover, astronomers and technicians of Korea visited China frequently for the study of astronomy and instrument making, and they brought back the new published books or useful information. As a result, Chiljeongsan Oeapieon 七政算外篇 which was a Korean edition of Islamic calendar, Huihui-li 回回曆 was published in 1444 with the Chiljeongsan Naepieon

七政算內篇 based on the Chinese calendar, Shoushi-li 授時曆. At the same time, in this process, many of Chinese and Islamic calendrical books were corrected by the Korean astronomers and reprinted by the new developed metallic type, Gabinja 甲寅字. In addition, astronomical instruments of Islamic influence such as water clocks with the automatic system, scaphe sundials, simplified armillary spheres etc. were re-made or newly modified in Korea. Also, it was known that there were many of inventions and innovations in astronomical and horological devices of this period. Consequently, through the great astronomical undertaking King Sejong reign, Korean science and technology were not only influenced by those of China and Islamic world, but also made remarkable improvement and progress.

Manolis KARTSONAKIS | Hellenic Open University, Greece

The Greek astronomical tradition in non-astronomical Byzantine treatises on nature sixth to thirteenth centuries

The study of treatises on Nature of the Late Antiquity and the mid-byzantine period offers us the tracing path that leads from ancient Greek science to the late medieval period achievements. We intend to focus on the astronomical principles presented in some byzantine treatises which indicate the living tradition of the ancient Greek scientific spirit within the Greek-speaking, Christianized, Byzantine Empire. Mainly, we will present certain astronomical principles which can be found at Cosmas Indicopleustes' Christian Topography (6th century), at Symeon Seth's Summary of Physics (11th century) and Nickephorus Blemmydes' Summary of Physics (13th century). The quotes which can be found in these essays indicate the wide knowledge of the authors on fundamental issues of the Astronomy as they had been derived from ancient Greek astronomical texts which were preserved in the byzantine territories. Also, the extended timeline of these references outlines that the Greek tradition on Astronomy had been active all the medieval period in the areas that were ruled by the Byzantine Empire and consequently could be transferred beyond the frontiers, to the territories of the eastern Empires through travelers and diplomatic missions.

DENG Kehui | College of Humanities and Sciences, Donghua University, China

A few questions on the astronomical observations in *Chongzhen Lishu*

Abstract The original version of Yuelilizhi in Chongzhen Lishu is studied in this paper. Based on the comparison study, it thinks that the observation and the calculation of the lunar mean motion in Greece were introduced in Yuelilizhi. And these materials are from Ptolemy's Almagest. They have been studied in this paper that some concept and geometry explaining of the lunar mean motion, and Ptolemy's method founded on the observation and the hypothesis, and his demonstration based on the Euclid's Element. It is found that there were some disadvantages in the astronomical observation of the ancient China.

Commentary: **Efthymios NICOLAIDIS** | National Hellenic Research Foundation, Greece

S101. Ancient cultural and technological interactions between East and West along the Silk Road

Sponsoring bodies:

DHST East Asia Commission

Society for the History of Technology (SHOT)

Sat 27 July, 09:00–12:30 ▪ Roscoe 2.4

Symposium organisers:

ZHAO Feng | China National Silk Museum, China

Angela SHENG (non-participant) | McMaster University, Canada

Symposium abstract

Cultural and technological interactions and exchanges on the Silk Road were significant factors in the development of the great civilizations of the ancient world, and in several respects helped lay the foundations for the modern world. The archaeological excavations in recent years make abundant primary evidence available to research into ancient encounters and communications between East and West along the Silk Road, especially during the first millennium BCE. Textiles, metals and silicate artefacts are fundamental part of archaeological materials, how to interpret the importance of these historical relics needs to adapt a multi-

disciplinary approach, mainly including archaeology, natural science and crafts. In order to shed new light on the latest understanding of this issue within the framework of this Congress, we propose to organise a symposium entitled "Ancient Cultural and Technological Interactions between East and West along the Silk Road". This symposium will bring together a group of scholars who are experts in the studies of archaeological discoveries of textiles, metals and silicate artefacts along the Silk Road.

S101-A

Sat 27 July, 09:00–10:30 ▪ Roscoe 2.4

Chair: **Berit HILDEBRANDT** | Leibniz University of Hannover, Germany

ZHAO Feng | China National Silk Museum, China

Tie dye on the Silk Road

Tie dye is a resist dye process of binding and dyeing a piece of fabric to make pattern. There are basically three major tie methods to bind the fabric before the dye process: with only threads, with threads and needles and without threads.

The earliest tie dyed textiles are wools excavated from the Zangunluk, Cherchen, in southern Xinjiang. One of them was tied and dyed in circles within a check pattern, and the other was tied and dyed in the stripe pattern. Since the tomb is dated from the 10th century BCE, this excavation is probably the earliest evidence of the tie dyed textiles in the world. It shows that the history of tie dye on the Silk Road could be traced back to the early bronze age and first tie dyed textile is wool.

More tie dyed silk fabrics were found on the Silk Road during the 3rd to 4th centuries. Excavations in Astana in Xinjiang and Dunhuang in Gansu brought a big number of tied dyed silks from the 4th to the 9th centuries, but the earliest dated tie dyed silk was from a tomb in Huahai in Gansu, 376AD. The tie dyed silks were more collected in Shosoin, Nara, Japan, which tells that this technique was introduced to the far east of the world during the 8th century.

There are more illustrations of tie dye shown by the arts in various styles on the Silk Road from the 5th to the 8th centuries, for instance, decorative textiles in tie dye pattern on the murals in Kizil grottoes, tie dyed costume on the painted wooden figures found in Turfan, a tie dyed cover woven on the jin silk with Helios and his carriage, and even on those three color ceramics found near Xi'an, the capital of China during the Tang dynasty. All these evidences show how popular the tie dyed textiles were and how close the relationship between all these places was.

The power of the tie dye was getting stronger during this period too. Wax resist dye with dot pattern is considered as the imitation of tie dye during the 5th to 6th centuries. Jin silk started to copy tie dye pattern as a ground for some other animal motives during the 6th century. After the clamp resist dye was invented in the High Tang, 8th century, tie dye pattern was also made with clamps resist method, to make the patterning process easier than the real tie dye.

MEI Jianjun | University of Science and Technology Beijing, China

Metallurgical interaction along the Silk Road during the first millennium BCE

There is an increasing body of evidence demonstrating China actively interacted with Central Asia through various channels, especially the Silk Road, during the first millennium BCE. Such interaction played a crucial role in stimulating cultural innovations in both China and Central Asia. This paper intends to offer some observations on metallurgical interactions along the Silk Road during the first millennium BC, with a focus on the following issues: the early uses of metal cauldrons in Xinjiang – the spread of piece-moulds technology; the appearance of

inning technique in Gansu and Ningxia – the introduction of innovative metallurgical technology; the emergence of Chinese mirror tradition and its westward spread into Xinjiang and further west. It is argued that cultural interactions have never been operated in one direction and metallurgical interactions along the Silk Road during the first millennium BC have considerable impact on the transformation of material cultures in both China and Central Asia.

Zhou Yang | China National Silk Museum, China

A study of different silks along the Silk Road

Silk was made from various breeds of lepidopterans, both wild and domestic. Though the wild silks were produced in many countries, such as India and Greece, there is no doubt that China was the first to domesticate the *Bombyx mandarina* into its descendent *B. mori*. on such a large scale, having the most effective species for silk production. The earliest evidence of silk was found at the sites of Yangshao culture in Xiyinchun, Shanxi, where a silk cocoon was found cut in half by a sharp knife, and Qingtaichun, Henan, both located in northern China and dating back to between 4000 and 3000 BCE. Another important find was from the Qingshanyang site, Zhejiang, in the southern China, dated back to 2000 BCE. The species from the north was identified as *Bombyx mori*, the domesticated silkworm, while the one from the south is more similar to the wild species from the shape of the cross section.

After the opening of Silk Road, the sericulture was introduced from inland China to Central Asia, via Xinjiang. A number of archaeological discoveries along the Silk Road, such as Yingpan, Xinjiang and Munchak-tepe, Uzbekistan, showed the long-term and frequent intercourses. We have done a number of silk fibre studies, and found both domestic and wild silks used on the Silk Road, meaning that not only domestic silk was traded along the Silk Road, but also some different species of wild silk, though we do not know which species it is nor where it was from. So our future study will focus on different silks along the Silk Road and find more interesting exchanges between the east and the west.

S101-B

Sat 27 July, 11:00–12:30 • Roscoe 2.4

Chair: ZHAO Feng | China National Silk Museum, China

Berit HILDEBRANDT | Leibniz University of Hannover, Germany

Silk production and the silk trade in the Roman imperial period

Silk was a much sought-after commodity in Roman imperial times. Many ancient texts deal directly and indirectly with questions concerning the origin, production and processing of silk. In my talk I will investigate the ancient terminology of silk as well as its supposed origins and ways of exchange along the Silk Road as presented in ancient text sources. In particular I would like to deal with the following questions: What kinds of silk were known in the Mediterranean area, and where did they supposedly come from? What can we learn from written sources about its production and processing? Which finished products are mentioned?

Donald B. WAGNER | University of Copenhagen, Denmark

Early iron in China

The technique of iron smelting appears to have come to the Central Plain from Xinjiang, and it is something of a mystery how the technique came to Xinjiang. Perhaps it came from the Chust culture in Ferghana, but the possibility of independent invention cannot be entirely dismissed. In the Central Plain the first smelted iron was used as a substitute for meteoritic iron in prestige weapons, but the Iron Age began with the invention of cast iron, perhaps in the 6th century BCE.

Zvezdana DODE | Southern Scientific Center of Russian Academy of Sciences (SSC RAS), Russia

WITHDRAWN: On the problem of attribution of velvet fabrics from medieval tombs of the North Caucasus

S102. The historical and cultural dimensions of Islamic science

Sponsoring body:

CHOSTIS: DHST Commission on History of Science and Technology in Islamic Societies

Fri 26 July, 09:00–15:30 • Uni Place 2.218

Symposium organisers:

Jan HOGENDIJK | University of Utrecht, Netherlands

Robert MORRISON | Bowdoin College, United States

Symposium abstract

Our symposium aims to situate science in its historical and cultural context within Islamic societies. As the history of science in Europe and North America continues to be dominated by studies of 1800 onward, it is particularly important for a commission like CHOSTIS, with a global membership and broad chronological scope, to join the discussion.

The particular areas covered by the panel include geography, medicine, mathematics, the relationship between science and philosophy, transmission of science, and biographies of scientists. This symposium will explore the relationships between medical knowledge and philosophy and astrology, geography and the exact sciences, science and other religious considerations, and the transmission of science.

S102-A. Transmission of knowledge over time and between cultures

Fri 26 July, 09:00–10:30 • Uni Place 2.218

Chair: Robert MORRISON | Bowdoin College, United States

Emilia CALVO | Universitat de Barcelona, Spain

Rosa COMES | Universitat de Barcelona, Spain

The transmission of Arabic astronomical tables into Latin: the case of al-Battani's al-Zij al-Sabi

The transmission of astronomical texts from Arabic into Latin in the Iberian Peninsula started as early as the 10th Century. Some of these translations made their way through the European continent and in some cases deeply influenced the works of later European astronomers.

One of the most interesting examples of this phenomenon is, without any doubt, that of al-Battani's astronomical book called *al-Zij al-Sabi*. But being as important as it is, there is no study up to now of the Latin translations of this text. The only complete study of the original Arabic text is due to Carlo Nallino back in the 19th century.

The aim of the paper is to present some of the features that can be derived from the comparative study of the original Arabic text of this *Zij* and the Latin translation compiled in the 12th century in the Northern regions of the Iberian Peninsula by Plato of Tivoli.

Constantin CANAVAS | Hamburg University of Applied Sciences, Germany

Qazwīnī's curiosities: multiple paths from late antiquity to Persian and Arabic/Islamic cosmography

The treatise *'Ajā'ib al-makhlūqāt*, written in Arabic by Zakarīyā Muhammad al-Qazwīnī in the 2nd half of the 7th/13th century, i.e. during the turbulent times that followed the Mongol raids and the fall of Baghdad, goes beyond the *'ajā'ib* tradition (narrative of wonders) and marks an apparently late *genre* of the Arabic (scientific) literature, usually characterised as cosmography. The large spectre of subjects of the celestial and terrestrial domains treated there has been a challenge for scholar studies concerned with tracing the origins of the treatise, as well as the transmission paths of knowledge conferred and its various representation forms. The common assertion of Greek-Aristotelian influence, however, does not explain the structure of the treatise, and does not elucidate the specific interests of the author as they are reflected in the contents of the treatise (e.g. in treating such subjects as planets, angels, curiosities, and monsters).

The present study proposes a network of multiple paths through which classical Greek (peripatetic) and early Christian cosmological concepts, as well as geographical and paradoxographical traditions of the late antiquity – presumably rearranged in new narrative patterns through Persian scholars – met Arabic/Islamic cosmological traditions documented or reflected in *tafsīr* and *hadīth*, and, by the end of the 6th/12th century, formed a conspicuous background of narrative and imagery for the emerging of Qazwīnī's cosmography. The focus of the study lies upon tracing the intermediate stages, both inside the Arabic/Islamic tradition (e.g. the integration of descriptions of marvels and monsters from the Greek paradoxographical and geographical texts into the Arabic *genre* of *'ajā'ib*) and outside it. The latter category comprises the Nestorian/Christian traditions of cosmological concepts and their affinities to a treatise which can be considered as the mediator between Arabic and Persian cosmographies, the *'Ajā'ib al-makhlūqāt* written in Persian by Muhammad b. Mahmūd Tūsī during the 2nd half of the 6th/12th century, i.e. one century before al-Qazwīnī. Precisely in the Persian literature of the early 6th/12th century we can trace a textual restructuring and abridging of the Aristotelian cosmological model towards a narrative intended for a popular understanding of physics and of the imagery of the universe. Perhaps it is due to this deliberate Persian "modulation" towards a popular form of cosmography that the Arabic cosmography of al-Qazwīnī could combine the popular topics of the Arabic/Islamic *'ajā'ib* tradition with the Aristotelian vision of nature and universe, thus establishing in Arabic a heritage continuance based on Greek, Persian and Arabic lineages.

Marina TOLMACHEVA | Washington State University, United States

Sailing the Indian Ocean: knowledge and culture in medieval Arab narratives

This paper focuses on transmission and absorption of geographical, astronomical, and cultural knowledge about the Indian Ocean in the pre-modern Arab world. Medieval Arabic sources offer information regarding both practical and academic learning, especially as it pertains to the western Indian Ocean. However, fewer works combine geographical knowledge with awareness of the societies on the Indian Ocean rim and of their culture. Even fewer articulate the value of such awareness, information and cultural attitudes to the practical need of applying their knowledge to task. Some of the stories of the 10th century compendium *The Wonders of India* made it into the tales of Sindbad the Sailor in the *Arabian Nights*, while the famous Arab navigator Ahmad ibn Majid (late 15th century) inserted brief comments on local societies in his descriptions of the oceanic routes from the Red Sea to Eastern Arabia, from India to southeast Asia, and from Gujarat to East Africa and Madagascar. From the semi-fantastic stories of the former to the supremely practical sailing instructions of the latter, a large gap exists in the sources and in our understanding of how the educated traveler and the sailor saw the same coast and the same society. Among classical Arab geographers and cosmographers few explored the Indian Ocean littoral (an important early exception is al-Mas'udi). However, travelers like Ibn Battuta (14th century) left rich narratives of intercultural

experience that allow us to trace some of the routes or channels of transmission of the knowledge both scientific and cultural. An attempt will be made also to identify the cultural and intellectual attitudes which facilitated or prejudiced the bridging of information and ideas between the world of Islam and other civilizations.

Gulfishan KHAN | Aligarh Muslim University, India

The genetic lineage of a family of medieval Indian scientists

The paper seeks to study and to throw light on the achievements in the domain of Mathematics, Science, Architecture and Astronomy of the illustrious family of Ahmad Mimar, the versatile royal architect of the Mughal Emperor Shahjahan (1628-58). His name is also associated with the planning and supervision of the construction of the Taj Mahal in Agra and the Red Fort in Delhi. He was also honoured with the title of *Nadir al-Asr* (The Wonder of the Age) by the Emperor Shahjahan himself.

His sons Lutfullah (who was honoured with the title of "Muhandis") and Ataullah have made great contributions in the fields of mathematics and astronomy. Their works also consist of translations of ancient and medieval classics such as *Khulasat al-Hisab* of Bahauddin Amili and mathematical treatises of Bhaskar. They also contributed to literature in the form of beautiful Persian verses and compiled anthology of poets. Belonging to a family of strong moral and ethical values they had their say on the subject of ethics. Nurullah, the youngest of the three sons of Ahmad was a practised calligrapher. The scientific and architectural achievements of the distinguished family have also been set down by Lutfullah in the form of Persian verses called *Diwan-i-Muhandis*.

Ahmad Mimar's grandsons Imamuddin Reyazi and Abul Khayr Khayrullah Khan (d. 1747) also distinguished themselves in their respective fields. Imamuddin Reyazi dealt with mathematics and astronomy while his brother Abul Khayr Khayrullah Khan collaborated in the compilation of the astronomical tables of emperor Muhammad Shah which are known by the name of *Zij-i-Muhammad Shahi*. Khayrullah's son Muhammad Ali Reyazi contributed to the subject of mathematics too. The factors which played an important role in the emergence of the family as well known medieval Indian scientists are a high level of literacy and royal patronage. Although their writings in the form of poetry, scientific treatises, translations, commentaries and glosses are scattered throughout the libraries of South Asia as well as in the Oriental Collections of Europe, they have not been studied much.

S102-B. Medicine in context

Fri 26 July, 11:00–12:30 • Uni Place 2.218

Chair: Gulfishan KHAN | Aligarh Muslim University, India

Theo LOINAZ | Universitat de Barcelona, Spain

Alexander Trallianus Arabus: on the fortunes of Alexander of Tralles' works in the Arabic Islamic medical tradition

Being, alongside Oribasius and Rufus, one of the very few Graeco Hellenistic medical authors to have been translated into Latin in Late Antiquity (with MS copies dated from ca. AD 800), sixth-century Trallian doctor Alexander's *Θεραπευτικά* can be reckoned among the most important auctoritates both in the history of Byzantine medicine (from Paulus of Aegina down to Myrepsus and Actuarius) and in the Latin West, where it was quoted all through the mediaeval period, some excerpts therefrom appearing even in an Old English Leechbook dated before AD 900.

As to the textual transmission of his oeuvre and after Puschmann's critical edition of the Greek texts, the attention has lately been drawn to the Latin tradition of the *Theraapeutica* (Langslow 2006, a set of prolegomena to his forthcoming critical edition) but, in spite of its being duly mentioned or cursorily surveyed by scholars dealing with medical matters (Puschmann, Bloch, Sezgin, Ullmann), the Arabic transmission

of Alexander of Tralles works still awaits for a comprehensive research. The only witness we have to reconstruct this tradition being the less than two scores of quotations to be found since the earliest eastern compilations, the present contribution is submitted as a prefatory sketch of such a study, modelled after Pormann's paradigmatic study of the oriental tradition of Paulus of Aegina's *Pragmateia*. The analysis of the Arabic tradition (which quotes several titles besides Alexander's therapeutical handbook [kunnāš]) may help shedding some light on the ascription to Alexander in the Greek and Latin traditions of several minor texts more or less suspected of pseudoepigraphy. As a necessary complement to the strictly philological section, we would like to advance as well some preliminary reflections on the different interests aroused in the Arabic Islamic medical tradition by Alexander's eminently practical approach to medicine. Although fully inscribed in the classical Hippocratic-Galenic tradition, his works are marked by eclecticism, originality and witty criticism with respect both to his predecessors and contemporaries. Among Arabic-writing physicians, his recurrent resort to his own long-life qualified experience (πείρα) did not pass unnoticed by the taḡribah-focused empiricists, neither did the role played therein by natural remedies (φυσικά, including amulets and incantations), an aspect dearly favoured by the Arabic ḥawāṣṣ literature with a much more pronounced leaning towards magic.

Miquel FORCADA | Universitat de Barcelona, Spain

The Aristotelization of science in twelfth-century al-Andalus and its influence on medicine

The research done in the last decades on the on the works written by the well known philosophers of the Muslim Iberian Peninsula who flourished in the 12th century - Ibn Bājjā, Ibn Rushd, Ibn Ṭufayl, Ibn Ṭumly's and so forth- has shown, among other findings, that: 1) in the first decades of the 12th century, Ibn Bājjā decided to practice science abiding strictly by Aristotle's doctrines and method, as a result of al-Fārābī's influence; 2) for this reason, he advocated empiricism and the harmonization of any scientific theory with Aristotle's tenets; 3) this line of thinking was followed up by Ibn Rushd and others in the second half of 12th century; 4) Ibn Rushd and Ibn Ibn Ṭufayl were possibly the focus of a medical school of sorts where they tried to give a sound exposition of medicine according to Aristotelian categories and reviewed critically some of the doctrines of Galenism. The paper will, on the one hand, add further insights to our knowledge of the historical context that surrounds the circle of physicians led by Ibn Rushd; on the other, study the more relevant criticisms that these scholars raised against Galenism in connection with what their Levantine predecessors - namely al-Fārābī and Ibn Sīnā- said about these issues. To that purpose, works little studied such as Ibn Tumul's commentary of Ibn Sīnā's didactical poem about medicine or Ibn Bājjā's commentaries of Galen's treatises will be analyzed

Glen COOPER | Brigham Young University, United States

Medicine and astrology in the Arabic tradition: uneasy dance partners

In spite of Abu Ma'shar's efforts to situate astrology soundly within a Neo-Platonized Aristotelian natural philosophy, not all medical thinkers of the Arabic tradition bought into his comprehensive scenario, which included judicial, or horoscopic divinatory astrology. Some, following al-Kindi, seem to have accepted his Platonic-Pythagorean preference for numerical harmonies over the data of experience, in which judicial astrology fit reasonably well. Others, beginning in al-Kindi's era, with Hunayn ibn Ishaq and Qusta ibn Luqa, at least, and continuing through Ibn Sina and beyond, seem to have accepted astrological influences of a general nature, while remaining skeptical about being able to draw precise prognostic connections between the stars and events on earth. This paper will consider the medical doctrine of the critical days, which straddles empirical science and astrological cosmology, and will examine how various thinkers from the Arabic tradition discussed and classified them. On the basis of this investigation, and as part of a larger

project that considers the historical relationship between these two disciplines, conclusions will be drawn, both about the connection of Arabic medicine to its source Graeco-Roman tradition, as well as to its daughter tradition in medieval Latin Europe.

S102-C. Mathematics, physics, and the heavens

Fri 26 July, 14:00–15:30 • Uni Place 2.218

Chair: Emilia CALVO | Universitat de Barcelona, Spain

Robert MORRISON | Bowdoin College, United States

Scholarly intermediaries between the Ottoman Empire and Renaissance Italy

Nicholas Copernicus (d. 1543) was the first person to propose a sun-centered cosmos for mathematical astronomy. But Copernicus did not cite earlier astronomers, whether from Europe or Islamic civilization, who worked within two hundred years of his own career. Leading experts on Copernicus have concluded that key aspects of Copernicus' astronomy must have come from astronomers working in Islamic lands in the thirteenth and fourteenth centuries. This paper investigates one conduit of scientific information between the Islamic world and Renaissance Italy, a network of scholars spanning Italy, Crete and the Ottoman Empire. One of the most remarkable members of this network was Jewish scholar named Mūsā Jālīnūs. Mūsū Jālīnūs, known in Hebrew as Moshe Galeano, spent time in the Ottoman Sultan Bayezit's court. By the first decade of the fifteenth century, Mūsā Jālīnūs had learned of important advances in astronomy, including some that later appeared in Copernicus' work. And in the first decade of the fifteenth century, while Copernicus was at the University of Padua, Mūsā Jālīnūs traveled to nearby Venice and met prominent figures there. Not only did some of the scientific theories that Mūsā Jālīnūs described in his writings appear in Copernicus' work but other theories that he described arose in the treatises of lesser-known Renaissance astronomers. The case of Mūsā Jālīnūs, and of the scholarly network more broadly, is an argument for not restricting oneself to the question of the transmission of Copernicus' sources, but for thinking more broadly about connections between the lands surrounding the Eastern Mediterranean and Renaissance Europe.

Montse DIAZ-FAJARDO | Universitat de Barcelona, Spain

The namudar of Ibn al-Kammad

Namudar is the Persian name of a technique used by medieval astrologers to know accurately the ascendant of birth.

In his study (1995/96), Edward S. Kennedy found four procedures for the *namudar*, all of them attributed to pre-Islamic sources as Hermes, Zoroaster, Vettius Valens and Ptolemy.

This paper explores the *namudar* described by the astronomer Ibn al-Kammad (fl. Cordova, 1116) in his treatise *Kitab mafatih al-asrar* (Escorial MS 939) of which, J. Vernet made a preliminary study in 1949.

Ibn al-Kammad's *namudar* presents some peculiarities, for example the use of the sidereal lunar month together with the synodic lunar month. For his *namudar*, Ibn al-Kammad employed parameters of the Andalusian astronomical tradition as well as numerical tables to obtain the gestation time.

Jan HOGENDIJK | University of Utrecht, Netherlands

Unusual mathematical constructions by craftsmen in a Persian manuscript on tilings

A well-known Persian manuscript on tilings which is now in the Bibliotheque Nationale in Paris contains a number of geometrical constructions which are unusual in the sense that constructions of this type occur only very rarely in medieval Islamic mathematical texts. These unusual

characteristics of these constructions will be discussed in the paper. In all likelihood, their authors were not learned mathematicians who had been trained in the Euclidean style, but craftsmen without "rigorous" mathematical training but with a strong intuitive geometrical insight. We will also offer some thoughts on the relationship between these craftsmen and scholarly mathematicians and astronomers.

Alnoor DHANANI | Harvard University, United States

Motion in a void in Islamic natural philosophy

In his seminal article on "The Dynamics of the Leaning Tower Experiment" published in 1951, Ernest Moody discussed Galileo's evolving views of motion in a void and its origins in the medieval Latin sources. The medieval Latin discussion of this problem, which as Moody notes derives from Text 71 of Aristotle's *Physics*, was influenced by Averroes *Large Commentary on the Physics* in which the dissenting view of Avempace or Ibn Bājja (d. 1139) is found, namely that motion of a void cannot be instantaneous and is therefore possible. Ibn Bājja's view is not unique in Islamic natural philosophy. It is found among the pre-Avicennan *mutakallimūn*, where it is formulated within the framework of atomist physics in which the fastest atomistic motion of one spatial unit in one temporal unit. The post-Avicennan discussion of Fakhr al-dīn al-Rāzī (d. 1209) is not formulated within atomistic physics, but rather as a critique of Aristotelian dynamics, just as it is in Ibn Bājja. This begs the question of whether this critique of Aristotelian dynamics is somehow related to the earlier *kalām* discussion, or whether the formulations of Ibn Bājja and Fakhr al-dīn al-Rāzī are drawing from an older tradition of the critique of Aristotelian dynamics. In my discussion, I will focus on the pre-Avicennan *kalām* discussion of motion in a void, then contrast it with the formulations of Ibn Bājja and Fakhr al-dīn al-Rāzī, and finally speculate on the relationships of these formulations with each other and with earlier discussions on this question.

S103. Gaining it / losing it/ regaining it(?) Knowledge production in climate science, status anxiety, and authority across disciplines

Sponsoring body:

DHST International Commission on the History of Meteorology

Fri 26 July, 09:00–17:30 • Uni Place 1.218

Symposium organisers:

James FLEMING (non-participant) | Colby College, United States

Vladimir JANKOVIĆ | University of Manchester, United Kingdom

Symposium abstract

Climate change discourse is not, and perhaps never was, "owned" by the climatological science community. Given the recent and heated "climate wars," it is fruitful to examine the status anxiety in this field from historical and science studies perspectives.

The symposium addresses "knowledge at work" through case studies of knowledge-making, loss and regaining of knowledge-use, and dissent and authority in climate science and, by comparison, in other discourse communities.

The symposium begins by focusing on "Gaining It"-that is, on concerted attempts to apprehend climate change, stake out authoritative positions, and forge climate "consensus" from Antiquity to the Intergovernmental Panel on Climate Change (IPCC). Throughout history understanding of climate change has been built on layer after layer of authority, prestige, data, experiments, theory, modeling, technology, and consensus. Does this dynamic also apply in different cultures and in other disciplines, for example in economics?

This is followed by case studies of "Losing It"-how atmospheric scientists lost control of the grand narrative of scientific interdisciplinary and technological progress central to their field. Historically, climate (understood mainly as a cultural agent) followed the dominant Zeitgeist. Aristotelians, Enlightenment philosophes, colonial agents, and others linked their theories to larger trends in political and popular culture, specifically to their views on geography, race, and health. Is climate a world narrative or a Western narrative?

In recent years new voices from the press, the public, the state, and the environmental movement have flooded the literature adding polarizing voices, while venerable but vulnerable practices of peer review and journal publication have taken back seats to the new electronically facilitated "peer-to-peer" review and ubiquitous blogs, tweets, and quacks. A division of climate labor has not produced a unified product - instead it has generated interdisciplinary status anxiety.

A third session, involving scientists and STS scholars will look at "Regaining It," that is the path forward (if any) toward a coherent perspective on climate affairs. Do the histories of climate science, the related social science, and popular perceptions of climate change follow parallel narratives? If not, what are the major differences? Are definitions of climate as agency and climate as index two separate entities, or is there some common ground?

The fourth session includes scholars from other disciplines examining the gaining it/ losing it/ re-gaining it theme in comparative perspective.

S103-A. Climates of conquest? Anxieties about climate variability and change in Africa, the Americas, Asia and Australia

Fri 26 July, 09:00–10:30 • Uni Place 1.218

Session organiser: Ruth MORGAN | Monash University, Australia

Chair: Vladimir JANKOVIĆ | University of Manchester, United Kingdom

Georgina ENDFIELD | University of Nottingham, United Kingdom

Articulating anxiety: drought, water scarcity and litigation in colonial Mexico

In this paper I draw on the rich colonial archives of Mexico to explore how anxieties over climate variability and specifically droughts, were articulated in legal proceedings over natural resources. There are thousands of lawsuits (*pleitos*) from the colonial period charting instances of illegal water use, water monopolisation, diversion, water theft, deprivation and usurpation and requests for reinstatement of water rights and all cross-sections of society appear to have been involved in water disputes at some stage throughout the colonial period. The degree of antagonism over this most essential resource, however, appears to have been exacerbated by drought, while a fear of water deprivation or perhaps memory of the impacts of drought induced scarcity underpinned many of the documented water disputes. In as much as there may be some association between drought and an escalation in disputes over water, I wish to demonstrate that there was a strong element of

opportunism in water litigation, and an awareness of the propensity for drought and its impacts may have been employed by litigants as a legal “tool” to reinforce or refute claims of water shortage, monopolisation, deprivation and/or restitution.

Philipp LEHMANN | Harvard University, United States

The desiccation of the world: debates on climate change and geo-engineering in colonial desert environments

The current debates on global warming have proved to be successful in sharpening our understanding of anthropogenic environmental changes in our past, but less so in tracing the historical dimension of thoughts and theories of climate change. This paper examines the history of the growing awareness of environmental change in the second half of the nineteenth century. It will examine the connection between European Sahara expeditions, colonial development in North Africa, and emergent theories of climate change and desertification. Contrary to the modern concerns with atmospheric gases, the nineteenth-century debate revolved around deforestation, sunspots, and soil erosion, but it was fueled by anxieties of environmental decline and resource scarcity that at times seem eerily similar to our own apprehensions today. The debate was also connected to political and technological concerns, or the aspirations of correcting “nature’s wrongs.” Climate change theories did not remain in the academic realm for long, but soon found their way into large-scale engineering plans of environmental transformation, or man-made climate alteration. This paper explores how the encounter with the Sahara and the wish to transform it into an economically usable landscape fueled the debates on climate change and desiccation, which came to be one of the most hotly debated issues in the European scientific community of the late nineteenth century.

Chris O'BRIEN | Charles Darwin University, Australia

Deliberate confusions

Climatic variability throughout tropical Australasia is a relatively recent 'discovery'. While weather extremes have long been recognized - and even celebrated in Australia - they have been understood as deviations from orderly norms. Any sense that such varying weather constituted an inherently variable climate was, until recently, peripheral to thinking about weather and climate. However, this belated recognition of variability has been concurrent with awareness of anthropogenic climate change. Unsurprisingly, climate change deniers have appropriated variability to dispute that human induced climate change is underway. This paper challenges so spurious a misuse of such a vital climatological concept. Examining the Dutch colonial encounter in Indonesia and the British experience in northern Australia, I will also sketch how variability became invisible to European observers in Australasia. Then this paper will show how variability, finally, came to be recognized. These histories reveal how the modern propensity to impose order and patterns has shaped contemporary understandings of weather and climate. But they also demonstrate the difference between variability and climate change. In particular, these histories attest the incoherence of climate change deniers' deliberate confusing of two distinct phenomena.

Ruth MORGAN | Monash University, Australia

El niño at the edge of Empire: Indian and Australian meteorology in the late nineteenth century

Growing scientific understandings of the El Niño-Southern Oscillation phenomenon have inspired a fruitful area of historical scholarship to explore its violent past, with important work by Richard Grove, Mike Davis and most recently, Don Garden. Their studies provide a foundation for this paper in which I will examine the scientific research of the emerging meteorological communities in India and Australia in the late nineteenth century. In India, the first director of the Indian Meteorological Department, Henry Blanford, and in Australia, colonial meteorologists Charles Todd and Henry Russell, attempted to identify

weather patterns in order to prepare long-term forecasts. Each sought to predict the onset of atmospheric changes that could produce catastrophic consequences, and to overcome their environmental anxieties about apparently volatile climates. Engaging in imperial networks of intellectual exchange, accelerated by telegraphy, these meteorologists in India and Australia shared and compared meteorological data in order to identify the larger weather patterns at work. The aims of this paper are twofold: firstly, to contextualise the collaboration of Indian and Australian meteorologists in relation to the developing scientific and professional study of meteorology in the metropole; and secondly, to situate their research in the nascent scientific communities of India and Australia in the late nineteenth century. This exploration of Indian and Australian meteorological research at the global, transnational and local scales will provide insights into the competition for climate knowledge and scientific authority, and the political and intellectual consequences of these struggles.

S103-B. Narratives on climate and water

Fri 26 July, 11:00–12:30 • Uni Place 1.218

Session organiser: Christina BARBOZA | Museu de Astronomia e Ciências Afins, Rio de Janeiro (MAST), Brazil

Chair: Ruth MORGAN | Monash University, Australia

Priscila FAULHABER-BARBOSA | Museu de Astronomia e Ciências Afins (MAST), Brazil

Anthropology of weather among the Ticuna Indians

I understand anthropology of weather as a specific body of understandings and abilities apprehended by imaginative knowledge inserted in particular forms of culture. I will analyze in this paper how Ticuna interpret the influence of weather climate changes on seasonality. This indigenous group's daily life along the Amazonas-Solimões tributary *igarapés* (or headwaters) revolves around their calendar of subsistence activities on which depends the reproduction of Ticuna society. In its morphology, mythic enunciation in songs and ritual discourse prescribe a socially-defined order that is justified within an ideological framework in which ethnicity is a vehicle of Ticuna expression in both national and international languages that cross over indigenous boundaries of civilization. Anthropology of Ticuna knowledge depends on analyzing ideological systems of how they understand the relations between sky-earth and social relations. The Ticuna believe that the celebration will bring success in subsistence activities such as hunting, agriculture and fishing. There is an intrinsic relation between these ritual activities and the Ticuna's representations of the environment in which they live. According to anthropological analysis, ritual is a social-action system that articulates cosmic order and social organization.

According to the explanations found in the headwaters or *igarapés*, the influence of weather climate changes on seasonality upon Ticuna subsistence strategies is more marked along the Solimões river (upper Amazon river in Brazil), given than in the headwaters of the *igarapés* plenty of plants and fruits are available all year long. The same occurs with fishing in environmental sanctuaries, where residents are able to supply themselves abundantly with fish all year long. On the Solimões, however, when the water level of the river rises, a certain degree of flexibility exists in the adaptation of the agricultural and extractive calendar to the rainy season when fishing and hunting are not productive and during the dry season when there is greater abundance, but the difficulties involved in navigation and transport grow as the water level along the *igarapés* linking the rivers drops. Traditional culture is not prepared, however, for unforeseen alterations in the rainy season, as has been the case at least in the last twenty years.

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Mark CAREY | University of Oregon, United States

WITHDRAWN: Climate change and water narratives in the Andes and Himalayas: science, discourse, and practices

Christina BARBOZA | Museu de Astronomia e Ciências Afins, Rio de Janeiro (MAST), Brazil

The scientific controversy over the Brazilian great drought of 1877-1880: science under scrutiny

On Köppen's classification, the central part of Northeastern Brazil has a semi-arid climate. This climate is generally associated with famine and internal migration to the coastal cities and to the South. Since the beginning of the 20th century it is also associated with political backwardness, due to the federal government mitigation policies based on dam construction and water and food distribution, both of them controlled by the local politicians and landowners. However, the social representations of the "sertão" associating its climate with poverty and political lag are quite recent. The turning point was the Brazilian great drought of 1877-1880, which raised a scientific controversy within the Polytechnic Institute in Rio de Janeiro involving the most prestigious scientists of the time. This paper explores the controversy between those who argued that the Northeastern climate was changing and those

who claimed that the droughts were cyclical natural phenomena. On the one hand, the engineer Manuel Buarque de Macedo and the geographer Tomas Pompeu de Souza Brasil, then senator by one of the provinces stricken by the drought, were among the ones who believed that human action, and especially deforestation, had diminished the frequency and intensity of the rain. They believed that the construction of large dams could improve the climate by stimulating the evaporation and causing rain. On the other hand stood alone João Ernesto Viriato de Medeiros, an engineer who argued that climate could not be changed but could rather be predicted. To achieve the latter, he proposed to collect meteorological data through a network of stations created and maintained by the Imperial government. Another engineer, André Pinto Rebouças, also shared the opinion that Brazilian droughts were periodic and above human intervention. In recent years a consensus has emerged within the climatological community that the so-called Great Drought that between 1876 and 1879/80 afflicted Brazil, India and Australia was caused by Nature, specifically by a natural fact now well established and known as the El Niño-Southern Oscillation (ENSO). The question raised at the end of the 19th century by some Brazilian scientists remains thus rather actual: in face of the news of an inevitable drought, should the inhabitants of the "sertão" simply leave their houses and wait for charity and governmental aid?

Eve BUCKLEY | University of Delaware, United States

Scientists' authority and Brazil's twentieth-century drought crises, or: is drought fundamentally a climate problem?

In 1909, the Brazilian government established an Inspectorate for Works to Combat Drought (now DNOCS) in the country's semi-arid northeast interior. This was the federal government's response to the recurrent humanitarian crisis caused by droughts and harvest failure, when many residents of that region died from starvation or disease. Over its century-long history, DNOCS has overseen the construction of numerous roads, reservoirs and irrigation networks, all theoretically aimed at reducing the human suffering caused by droughts. As many critics have noted, the selection and placement of these infrastructural investments have aided landowning elite ranchers and farmers far more than they helped the landless poor. Development funds provided by DNOCS and related agencies have been justly maligned as a "drought industry" that takes advantage of the sympathy engendered by the climate crisis to funnel resources coveted by regional politicians (and their well-placed clients) into the federally underserved *sertão*.

This paper examines analyses of the drought crisis and its human costs made by agency technocrats who worked on the front lines of federal infrastructure projects in the interior northeast. Such projects employed male heads of refugee families who constructed reservoirs, roads and irrigation canals largely by hand. In return for this backbreaking labor, their families received daily food rations deemed just sufficient for survival.

The civil engineers and agronomists who managed such emergency public works projects developed an understanding of the drought problem focused on many factors other than climate. Civil engineers sent to the parched *sertão* to confront desperate poverty and epidemics around worksites often came to view the crisis as resulting from power imbalances and inequality as much as from any natural factors. This was echoed forcefully by development economists engaged in regional planning from the 1950s on. Agronomists, employed by the agency since 1932, focused on the cultural impediments to climate cycle adaptation among the *sertanejo* poor. They agonized about the lack of discipline and cooperative community spirit that hampered their establishment of irrigated smallholder colonies throughout the *sertão*.

These technocratic cohorts strove to assert their scientific authority in order to reorganize *sertanejo* society in ways they believed would make the region less vulnerable to drought and reduce the suffering of the very poor. They were frequently thwarted by both elite and popular sectors who rejected the scientists' expertise in favor of their customary social

organization. Many elements of this history are relevant to contemporary debates about adaptation to the realities of climate change and its resulting natural disasters.

S103-C. Working atmospheres: histories of climate, technology and economics

Fri 26 July, 14:00–15:30 ▪ Uni Place 1.218

Session organisers:

James KNEALE | University College London, United Kingdom

Samuel RANDALLS | University College London, United Kingdom

Chair: David HIRST | University of Manchester, United Kingdom

Franz MAUELSHAGEN | Institute for Advanced Study in the Humanities, Germany

The debate over climate change in historical time, c. 1700-1850

The debate over climate change in historical time, i.e. the period in human history for which written record exists, goes back to the quarrel between the Ancients and the Moderns which involved a “dispute of the New World” (Antonella Gerbi). In this context, naturalists of the eighteenth century discussed whether the climate of the Italian peninsula had been warmer and more humid in Antiquity as compared with the present, whether there had occurred a deterioration of climatic conditions that contributed to the decline of the Roman Empire (Edward Gibbon) and, last but not least, how the climates of North America compared to European climates (Buffon, Jefferson etc.). How did climatic differences between the Old and the New World relate to differences in flora and fauna, and what did it mean for Europeans to migrate and adapt to climates in North America? Last but not least, European colonizers around the world sought to modify weather conditions, particularly in tropical colonies, through measures such as deforestation and desiccation. In principle, these debates are well known; however, neither has their scope been fully explored, nor has their relevance for the emergence of climatology as a scientific discipline been recognized. This maybe so because leading innovators in the field of climatology – e.g. Humboldt, Arago and Schouw – remained skeptical about the evidence or even rejected the idea of climate change entirely; or maybe because the nineteenth century made the groundbreaking discovery of geologic time and the Ice Ages. The Ice Ages of the Pleistocene made the Holocene climate look so stable that only very few climatologists attributed any significance to the variability of the latter. It took until the 1950s, before the idea of climate change in historical time experienced a revival that led to the foundation of a new branch, historical climatology (Lamb, Le Roy Ladurie, Pfister). This paper will review the debate on climate change in historical time between 1700 and 1850 and place it in the context of the “climatological revolution,” a term I am using to denote the emergence of climatology as a scientific discipline around 1800.

James KNEALE | University College London, United Kingdom

Samuel RANDALLS | University College London, United Kingdom

Weather, science and insurance in the UK and USA, c.1840-1920

Recent scholarship has begun to explore the connections between histories of science and histories of insurance, most notably with regard to medicine, and suggests that these encounters were highly productive, influencing theories of disease transmission, assessments of safe levels of drinking, and the medical examination itself. However there has been relatively little consideration of the extent to which insurantal practice

engaged with meteorology and climatology, or the consequences of this dialogue. In this paper, we examine the way in which insurers in the late 19th and early 20th century drew on, extended and created their own forms of science to enable them to turn weather and climate into an auditable risk for the purposes of establishing insurance contracts.

In particular, this will be explored through examination of two cases between about 1840 and 1920: histories of storm insurance and their relationship with meteorological science networks; and histories of life insurance and the evaluation of travel or residence in particular climates, literally mapping out different zones of risk. This draws from research on U.K. and U.S. based insurers and rather than being focused on a particular company tracks the emergence of what might be termed an insurance approach to weather and climate. Key questions include: to what extent did insurers draw on meteorological expertise or create their own? How did insurers monitor weather claims and payouts? How were claims adjudicated in the absence of meteorological records? What kinds of knowledge did insurers produce and in what ways was this different to contemporary scientific debates at the time? And did actuarial prudence outweigh science when it came down to assessing risk?

Simon CARTER | Open University, United Kingdom

Sunlight and health: modifying the sunlit climate

During the 1920s and 1930s a variety of forces came into play to weave sunlight, as a giver of health, into the fabric of social worlds. Both the *People's League* and the *New Health Society* played an active role in public health campaigns concerning the benefits of sunlight. Yet these organisations were not principally concerned with sunlight itself. Instead they sought to frame the health benefits of sunlight exposure in order to stabilise a specific social figuration as part of the broader social hygiene movement. However, in the early 1920s an organisation appeared that sought to actively promote the action of the sun's rays as being a health benefit in their own right and to materially 'domesticate' the sun's rays: namely Caleb Saleeby's *Sunlight League* founded in 1924. The League campaigned, both directly and via its journal (*Sunlight*), for a variety of causes such as, mixed sunbathing, open air schools and the general health benefits of sunlight. But foremost amongst these was the cause of smoke abatement. Smoke pollution was seen as a key threat to the health of urban populations because it deprived the climate of the 'health giving' effects of ultra-violet light. Saleeby came to refer to the combination of smoke abatement policies together with the prophylactic application of the sun's rays as *helio-hygiene*. In this paper I will examine the promotion of a sunlit climate in this period in order to chart the emergence of a nexus made up of bodies, sunlight and social worlds. I have termed this assemblage *the heliosis* – to capture the idea of an interactive stabilization between the various knotted couplings of the human body in a sunlit climate.

Alexander HALL | University of Manchester, United Kingdom

Thinking like a business: public weather services at the British Meteorological Office, 1953-1961

The 1950s saw the UK's Meteorological Office (MO), expand its provision of public weather services substantially. Influenced by US Weather Bureau practice, the new Director of the MO, Oliver Graham Sutton, sought to make weather information more available to the general public. To justify the increased government investment that such an expansion and broadening of services required, Sutton and other senior figures at the MO, influenced by German and US practice, began to explicitly highlight the economic benefits of their services across all sectors of British society. Adopting a cost-benefit approach, the MO began referring to products rather than services and customers rather than users. Such an approach also saw services created for specific user groups separated from, and on occasion replaced by, broader services for the public.

By investigating the increased MO emphasis on the utility of its services, this paper explores conflict within the organisation between its state role

in protecting civilians and property, and its provision of more commercial services, which were considered the realm of private companies in many other countries. The emergence of MO services as sellable products was clearly highlighted by the opening of regional weather centres throughout 1959-61; high-street premises with a shop front where both the housewife and the businessman could call in and purchase weather and climate products.

Many of the public services the MO began to offer in this period were influenced by new meteorological understanding and technological capabilities. In developing new forecasting methods into weather services the MO made decisions on how to communicate the organisation's scientific expertise to the public. Questions on the use of probabilistic versus deterministic language during forecasts, bespoke forecasts versus repeatable generalised services, and regional versus national scale forecasts all had to be addressed. From 1953-1961, the public weather service provision of the MO not only expanded, but became more business-like in approach. In turn this shift in emphasis influenced many of the organisation's decisions on how to produce and communicate forecasts to the public. Through investigating these changes this paper charts how the MO took new meteorological approaches and technologies and developed them into marketable products, which would appeal to a broad spectrum of British society.

S103-D. Climate change discourse and the case of the Intergovernmental Panel on Climate Change (IPCC)

Fri 26 July, 16:00–17:30 • Uni Place 1.218

Session organisers:

David HIRST | University of Manchester, United Kingdom

Martin MAHONY | University of East Anglia, United Kingdom

Chair: Samuel RANDALLS | University College London, United Kingdom

David HIRST | University of Manchester, United Kingdom

'An authoritative statement of the views of the international scientific community': the first assessment cycle of the IPCC, 1988-1990

This paper will examine the First Assessment Cycle of the Intergovernmental Panel on Climate Change (IPCC). Beginning in November 1988 the IPCC began a three-pronged process to: (i) Assess the scientific information related to climate change; (ii) assess the environmental and socio-economic impacts of climate change and; (iii) identify possible realistic policy and strategic responses for management of climate change. During this phase the IPCC panel members and working group chairs and lead authors contributed to an ad hoc approach producing "an authoritative statement of the views of the international scientific community at [that] time"(IPCC, 1990). At the outset of this process it wasn't at all clear that the IPCC would evolve into the authoritative forum for addressing climate change. But with the reports of the first assessment given pride of place at the Second World Climate Conference in 1990 the IPCC was clearly viewed by the scientific community as a credible organisation. Moreover, the institutional design of the IPCC –involving governments in the review stage –enabled considerable political buy-in. The strict timelines, governmental ownership and the involvement of several eminent scientists in the process meant politicians were interested, scientists engaged and the information produced was highly relevant and credible. In this paper I will investigate the decisions and processes that contributed to the anchoring of the IPCC as the central authority on climate related knowledge. It was during this assessment that the credibility, saliency and legitimacy of the IPCC was established. Ensuring the authority of the IPCC accelerated the political movement

towards the framework convention on climate change, signed into force at the Rio Summit in 1992. The decision of US policymakers to establish an assessment mechanism with an intergovernmental structure was a concerted effort to 'reign in out of control science-policy entrepreneurs.' This ultimately backfired as the scientific community produced the most authoritative, credible and widely legitimate report on climate change to date backing up the earlier findings so unpopular among US policymakers –namely a proposal for a framework convention on climate change.

Reiner GRUNDMANN | University of Nottingham, United Kingdom

'Climategate' and the problem of trust

The affair known as 'climategate' controversy has become a topic for interpretation and contention in the media, and also in some strands of the social sciences. Perhaps not surprisingly, it has become controversial among these social scientists, too. Scholars disagree about how to evaluate the exposed practices shown by the emails, especially if these should be seen as instances of scientific malpractice. However, there is general agreement that climate science needs more openness and transparency. This was the major finding of several official inquiries and is widely assumed to be a precondition for regaining trust. But when evaluating climategate there is a variety of responses, ranging from the apologetic to the highly critical, some even speaking of 'corruption'. This seems to indicate that the politicized nature of the debate (including climate science and social science reflection) has had a major impact. This could be problematic from a history of science perspective.

Martin MAHONY | University of East Anglia, United Kingdom

Science without borders? IPCC and the geographies of credibility

Much of the debate about the implications of recent controversies in climate change science has focused on the contested credibility of institutions like the Intergovernmental Panel on Climate Change in Western societies. The North American- and Euro-centrism of the debate may simply reflect the location of the controversies themselves and the geography of the media attention which they garnered. However, it may also reflect the frequent obfuscation of the complexity in how scientific knowledges and their attendant controversies travel. A growing body of work has shown that the perceived credibility and legitimacy of bodies like the IPCC is not universal, and concepts such as civic epistemology have been employed to show how the authorization of knowledge claims is shaped by local norms and practices of public knowledge-making at various spatial scales. The IPCC has employed a number of strategies to gain international credibility, for instance through targeted efforts to increase the participation of experts from developing countries – a strategy which is often presented as being more about gaining global assent than about diversifying the epistemological basis of its assessments. Drawing on my research on the relationship between the IPCC and Indian scientific and political communities, I explore how the acceptance of particular knowledge claims is contingent on local circumstances and political culture. A history of epistemic contestation between Indian and Western experts provides an important context for understanding the political effects of the so-called 'Himalayagate' controversy, which was a central part of the broader 'Climategate' episode of late 2009 and early 2010. A distinctive Indian civic epistemology which embraces the intermixing of the epistemic and the normative shaped the response to the episode, and illustrates that 'global credibility' is not just a simple function of sound science and international representation.

S104. Materials and chemistry from bench to brand and back

Sponsoring body:

DHST Commission on the History of Modern Chemistry

Fri 26 July, 09:10–17:40 ▪ Roscoe 1.010

Symposium organisers:

Pierre TEISSIER | Université de Nantes, France

Brigitte VAN TIGGELEN | Independent scholar, Belgium

Symposium abstract

It has become almost commonplace since the 19th century to emphasize how much chemists shape matter and build new materials, not only to enhance natural knowledge, but also in the hope of improving the human condition. By creating new, hopefully useful substances, chemists have established a role, not only in science and technology but also as architects of both matter and society. Less often stressed is how materials may in turn shape chemists and their science, both by creating or reorganizing disciplinary fields, communities, instrumental consensus and experimental practice and objects, and by initiating new behaviours in society and consumption or adding to the ever growing number of synthetics.

For example, consider the solid compounds extensively synthesized by inorganic chemists in the twentieth century. This led in the 1960s to the emergence of a new subdiscipline: solid state chemistry. Referring to themselves as “solidists”, solid state chemists became identified by their will to synthesize original solid compounds. These were shaped at the inner (atomic) level to exhibit new intrinsic properties. These pieces of matter rapidly escaped their creators to be transformed into “materials” by a new field, materials chemists, working at an intermediary (microscopic) level to turn solid compounds into commercial products with many uses, including ceramics, metallurgy, and electronics. The step from matter to materials was induced by the transformation of a bench compound to a brand product when solid state chemists, who exhibited properties, were replaced by materials chemists who stabilized the compound to make it useful. In the process two new subdisciplines of chemistry emerged. Ultimately the resulting new products have had a significant impact on modern consumption patterns and material culture. Introducing new materials into the environment has also posed unexpected challenges for regulation, clean-up, and recycling, which have in turn affected the activities of chemists and have led to the emergence of another new field, “green chemistry.”

There is thus a co-construction of the subject and object of chemistry, and in the frame of this symposium, we would like to invite further considerations of the mirror dynamism between people and materials in a wide range of interacting fields and levels of activity from bench research through engineering to human society and the natural environment. Up to now this has been mostly underlined in the field of inert or non-living materials, as in our example (other examples from the twentieth century could include the development of synthetic polymers and plastics); we also welcome case-studies and considerations from the life sciences, where the creation of new drugs or food ingredients may follow a similar trajectory (or not).

S104-A. Early synthetic materials

Fri 26 July, 09:10–10:40 ▪ Roscoe 1.010

Chair: Masanori KAJI | Tokyo Institute of Technology, Japan

Discussion

Including a welcome by Jeffrey Johnson, Chair of the Commission on the History of Modern Chemistry, and opening remarks by the symposium organisers

Pierre LASZLO | École polytechnique, France

Cellophane and viscose, from a multi-faceted chemical, with focus on their European origins

Viscose and cellophane are materials derived from the same chemical, nitrocellulose, an artificial derivative of a natural polymer. Their story splits into two autonomous narratives, for the fiber which became an inexpensive silk substitute, known as rayon; and for the transparent film, cellophane. Hilaire de Chardonnet, the original inventor, was educated at the École polytechnique, and interacted with Louis Pasteur in the 1860s, when the latter was investigating silkworms. Chardonnet set-up a viscose-manufacturing plant in Hungary. During the 1870s and 1880s, Jules Verne became obsessed with collodion, the mother liquor from which viscose fibers were spun, a multi-faceted miracle material for the novelist. I shall also sketch a parallel between the two derivatives, nitrocellulose, on one hand, cellulose acetate, on the other, to which we owe the birth and blooming of cinematography. Some of the other aspects of the viscose story include the dilemma of manufacturers in Lyon, faced with the rivalry between their traditional silk trade and the novel silk substitute; the manufacture of artificial polymers—celluloid and bakelite were others, at the turn of the twentieth century—in the contexts of the second industrial revolution in France and of transatlantic interactions; commercialization of artefacts from such polymers in the newly opened department stores, of which Boucicaut's Au Bon Marché in Paris—featured in Zola's novel *Au Bonheur des Dames*—was a resounding pioneering success. In addition, my family history—in Grenoble, during World War II and the German occupation, when my mother organized the Hungarian female workers in the local viscose manufacturing plant—intersected the history of this artificial fiber. Back to the bench? Cellophane was a daughter invention, perfected in 1908 by Jacques Edwin Brandenberger, a Swiss textile engineer. He had sought for several years a transparent packaging material. By 1908, Brandenberger developed the first machine for the manufacture of transparent sheets of derivatized cellulose. By 1912, Brandenberger was making a saleable thin flexible film, used initially in gas masks. After World War I, a company was set-up to manufacture and commercialize cellophane. In 1923, DuPont acquired the license for North and Central America. A DuPont scientist, William Hale Church, and a team of researchers figured out how to make cellophane film moisture-proof, launching its use in food packaging.

Joris MERCELIS | Ghent University, Belgium

Handling fundamental uncertainty: Bakelite and Baekeland in industry and academia

The invention of “Bakelite” phenolic plastic in 1907 preceded the appearance of the first comprehensive textbooks on macromolecular chemistry by more than two decades. And up to the late 1940s the growth of the industry to which this invention gave birth was not matched by a similar increase in the basic scientific understanding of the Bakelite process, particularly its final stages. Hence, a strong case could be made that fundamental science was largely immaterial to synthetic phenolic plastics' drive to industrial maturity. Still, already before the First World War Bakelite inventor Leo Baekeland and other entrepreneurial chemists associated with this industry advanced various interpretations concerning the molecular structures of these compounds, even though it was widely acknowledged that the empirical basis on which their “speculations” rested was weak. This paper analyzes the motives of Baekeland, a practically-minded innovator, for participating in this seemingly academic discussion. It is shown that intellectual property disputes provided one major impetus: Baekeland's theoretical deductions partly served to reinforce narratives about the history of his invention through which he and his associates sought to broaden the scope of their patents, in response to conflicting interpretations set forth by their competitors. But Baekeland's occasional digressions into chemical theory also followed from his inclusion in an academic, collegiate-reputational reward system to which normative ideals of disinterestedness and openness were central. In this respect, I connect Baekeland's work on Bakelite to his return to academia during the First

World War, approximately a quarter century after his resignation from a postdoctoral position in Belgium. In 1917 Baekeland joined Columbia University's newly established Department of Chemical Engineering as an honorary professor. And two years later his General Bakelite Co. began financing research at this department, in the form of an industrial fellowship that was claimed to be special on account of its commitment to "open science." Such scholarships helped Baekeland recruit well-qualified personnel for his company. Because of the research articles resulting from them, they also increased Baekeland's reputation as a scientific author, as well as his standing in a chemical community that was eager to promote phenolic plastics as an "entirely American" counterpart to the German-dominated synthetic dyestuffs industry.

Commentary: [Jeffrey JOHNSON](#) | Villanova University, United States

S104-B. Late advanced materials

Fri 26 July, 11:10–12:40 • Roscoe 1.010

Chair: [Ernst HOMBURG](#) | Faculty of Arts and Social Sciences, University of Maastricht, Netherlands

[Pierre TEISSIER](#) | Université de Nantes, France

Chemical identities and non-oxide glasses in the late-twentieth century

In the early 1970s, in the university of Rennes, Jacques Lucas and his co-workers were following the routine of solid-state chemists: the synthesis of new crystals with hopefully new physical properties. Marcel Poulain, a PhD student on a grant from the telecom company Alcatel, had spent time "putting" rare earth inside fluoride crystals. Someday in 1972, after he opened the furnace where the mixture had cooked, he found a disordered matter instead of the usual well-ordered crystal, i.e. a glass. He was about to throw this messy sample away when his supervisor pointed out, after a quick bibliography, that fluoride glass had never been listed. Since giving birth to a new substance is praised among chemists, the team dirtily investigated the chemical product and published a decent article. This case of serendipity left the solid-state chemistry community cold, but got a few theoreticians from Bell Labs excited when they read the empirical result in 1973: they had just predicted that fluoride glasses would provide optical fibres quicker than the ones in silica by Corning. As speed is the Holy Grail of telecoms, AT&T, NTT, and British Telecom rushed and turned upside down the quiet life of Lucas's laboratory by injecting money to convert bench products into materials. From then on, the capricious nature of fluoride glass reshaped the knowledge of its captive chemists: 1°) through characterizations, from X-ray diffraction adequate for crystals to thermal analysis and spectroscopy for glasses; 2°) through the art of syntheses, from the quest of original structures to the endless optimisation of chemical composition to reach the best possible optical "performance". This expertise shift entailed a community shift towards an international laboratory network which launched in 1982 an "International Symposium on Non-Oxide Glasses" (ISNOG). The superstar fluoride glass had only needed a decade to shape a new hybrid identity at the conjunction of telecoms, optics, chemistry and materials science. Another decade however was needed for the optimisation on a ZBLAN composition that was sold by a spin-off in Rennes, Le Verre Fluoré. As ZBLAN remained a brand product for high-tech instrumentation and did not reach the mass market, Lucas did not drop his academic identity for the spin-off and went back to the bench to study, with another PhD student, X. Zhang, a new glass based on tellurium. But this time, he got the ISNOG expertise to develop from bench to brand and back.

[Cyrus MODY](#) | Rice University, United States

An historical alternatives approach to the materials of microelectronics

When Gordon Moore first articulated his law of miniaturization in microelectronics manufacturing in 1965, silicon had only recently become the predominant material of that industry. In the '50s and early '60s, silicon beat out alternatives such as germanium. Over the next 50 years many other exotic microelectronics materials were proposed and investigated, but none seriously threatened silicon. These exotic alternatives – e.g., compound semiconductors, molecular electronics, superconductors, carbon nanotubes, etc. – hovered at the edges of the microelectronics industry. The enormous infrastructure dedicated to silicon, and the steady progress in circuits made from silicon, meant few firms were willing to develop a parallel infrastructure devoted to an unproven alternative. Yet as the infrastructure devoted to silicon became ever more capital- and technology-intensive, and Moore's Law more difficult to sustain, alternatives to silicon promised another way forward. The first published statement of "Moore's Law" (not called that at the time) was in Electronics Magazine. Journals of this type are usually referred to as the "trade press" because they circulate information among industry insiders and observers about the "trade" in which they are engaged. In this paper, however, I approach Electronics Magazines and its peers as what Kaplan and Radin have recently called "para-scientific media" – that is, outlets that are not heavily technical and do not play the same priority-staking role that scientific journals do, but that nevertheless actively construct the boundaries of technical communities. Exotic alternatives to silicon have been a recurrent object of fascination for the para-scientific media of the microelectronics industry. Semiconductor industry insiders need to know about them without investing too many resources into knowing about them; while proponents of these alternative materials need to signal to the semiconductor industry when they are ready for more intensive examination. The para-scientific media of microelectronics are perfectly positioned to facilitate that exchange. In this paper, I survey para-scientific microelectronics journals (Electronics Magazine, EE Times, IEEE Spectrum, etc.) from the late '60s to the present to see how they have presented exotic microelectronics materials, and how they have used those materials to construct the fluid boundaries between industry "insiders" and "outsiders."

[Matthew N. EISLER](#) | University of Virginia, United States

The uses of technofutures: the lithium economy, distributed industrialization, and the managing of power source heterodoxy

As in many fields of technoscience that have yet to yield commercial products, the contemporary advanced secondary (rechargeable) battery sector (constituted primarily around devices employing lithium-based chemistries) depends heavily on expectations of future applications in order to marshal resources to sustain ongoing research operations. As in the biotech sector, the product development time horizon has been protracted owing to a mix of physical and social factors. Put simply, it is more difficult physically to move molecules than, say, bytes. Despite recent enthusiasm from and considerable investment by sectors of heavy industry, the requirement that advanced batteries meet or exceed every performance metric of incumbent power sources (above all, the internal combustion engine, a technology whose efficiency is constantly being improved on a massive scale) constitutes an ever-shifting performance benchmark that battery technologists cannot hope to match in the near future. Despite industrial investment on the order of several billion dollars a year and the launching of commercial battery electric auto ventures, this vicious cycle virtually guarantees instability in this sector. Efforts to develop an industrial base around lithium-based battery chemistries are further complicated by asymmetrical relations of trade and technology transfer. A peculiar situation has resulted. The United States has been at a disadvantage in developing this industry owing to historical neglect of the field of electrochemistry. No large American company produces large advanced batteries, unlike U.S. partners/competitors in this field. And yet the U.S. auto market and the national research and development apparatus have become indispensable components of the advanced battery value chain. The

expansion of battery electric automobility, hence, would represent a sea change for the American auto industry, for it would mean that foreign firms would control the development and manufacturing of the automobile prime mover. This essay explores the emergence of the technoscience and political economy of the advanced battery sector as a means of elucidating the paradoxes of late-modern capitalism, above all, the relationship between existing, rapidly changing social relations of production and their justifying discourses, with a focus on lithium futurism.

Commentary: [Patrick McCray](#) | University of California, Santa Barbara, United States

S104-C. Infrastructure, instruments & ideas

Fri 26 July, 14:10–15:40 ▪ Roscoe 1.010

Chair: [Yasu Furukawa](#) | Nihon University, Japan

[Hyungsub Choi](#) | Seoul National University, Korea, Republic of

Creating a built environment for interdisciplinary research: materials science in the Cold War United States

Following the launch of the Sputnik in 1957, the U.S. government made a concerted effort to foster materials research, based on the assumption that basic research would allow for the development of advanced materials. The Federal Council on Science and Technology responded to the technological demand by suggesting the creation of federally funded interdisciplinary laboratories in universities, bringing together scientists from metallurgy, physics and chemistry to provide developments in fundamental research and to train a new generation of scientists. In 1960, ARPA implemented this plan and awarded three universities four year contracts to develop materials science. Within a few years, the program grew to twelve universities, when it was transferred to the National Science Foundation in 1972. Our paper considers the initial ARPA contract with the University of Pennsylvania in 1960, which set out to not only increase materials science knowledge production, but also to double the number of scientists trained in materials sciences. With ARPA funding, supplemented by university and private funds, Penn constructed a new building, the Laboratory for Research on the Structure of Matter (LRSM) to house its new interdisciplinary materials research program. In this paper we examine how the building's designs were meant to foster interdisciplinary materials research between members of several departments and how it was subsequently adapted to meet the demands of interdisciplinary research, highly-sensitive instrumentation, and changing scales and types of technological equipment. Perhaps most important in the plans for the new building were the Central Materials Processing Facilities, a series of shared laboratories and work spaces. In our study, we aim to understand the intended use of these Central Facilities in terms of encouraging interdisciplinary research and the subsequent series of renovations since the 1960s. Our source materials from the Penn archives include a rich collection of news releases, media coverage, original ARPA proposals, and LRSM Executive Committee meeting minutes. We also study the original – and subsequent – blueprints and floor plans for the LRSM. We seek to interpret how the evolving demands of technological and scientific research impacted the built environment, in terms of both successes and failures in attempts to foster interdisciplinary research, as well as the practical physical demands of new technologies.

[Mari Yamaguchi](#) | University of Tokyo, Japan

The direct observations of phthalocyanines: milestones in enhancing microscopic resolution

The phthalocyanines are functional materials known as blue-green synthetic dyes and organic semiconductors. P. Linstead and his colleagues succeeded in synthesizing the pigment and reported the molecular composition in 1934. In the same year, J.M Robertson determined the structures of phthalocyanines by X-ray diffraction analysis and revealed the shape to be reminiscent of a four-leaf clover. Thus, phthalocyanines were not only attractive as materials for industrial applications but their characteristic structures also drew the interest of microscopists. Phthalocyanines, on occasion, have been associated historically with electron microscopes, the Field Emission Electron Microscope, FEM, and the Transmission Electron Microscope, TEM. This paper traces the history of the electron microscopes through the studies of these chemical compounds, the phthalocyanines. E. Mueller reported the observation of phthalocyanine molecules using the FEM in 1950. This lens-free electron microscope has a high negative voltage applied to a metal tip encased in an evacuated glass tube. The image that appears on the fluorescent screen emanates from electrons that flow from the tip. For observation of the molecule, they are on the tip. At this case, the FEM became the best microscope in the world. Muller's interpretation of the images, however, faced skepticism based on the experimental and theoretical results of others. Consequently, his research led to a deeper understanding of surface diffusion. J.W. Menter accomplished the direct observation of the crystal lattice of copper and platinum phthalocyanine using the TEM in 1956. This microscope employs electron beams and magnetic lenses to magnify the sample. Menter suggested that the intuitive interpretation of lattice image was feasible. While many researchers questioned Menter's idea, several observations of crystal lattices and theoretical works supporting the mechanism of imaging were reported. Fourteen years later, N. Uyeda reported the observation of the hexadecachloro-Cu-phthalocyanine molecule, a species bearing the shape of a four-leaf clover. Finally, Uyeda and his colleague visualized the atoms in the molecule with supporting computer simulations enabling a reliable interpretation of the image in 1979. Through the history of direct observations of the phthalocyanines by the electron microscopes, these molecules became milestones on the road to the atomic resolution.

Commentary: [Jody Roberts](#) | Chemical Heritage Foundation, United States

S104-D. Modelling natural materials

Fri 26 July, 16:10–17:40 ▪ Roscoe 1.010

Chair: [Brigitte Van Tiggelen](#) | Independent scholar, Belgium

[Mathias Grote](#) | Technische Universität Berlin, Germany

Fermenting a 'biopolymer': visions of engineering a biological material in the 1980s

Projects to use biotechnologically produced materials have involved a combination of advanced, at times visionary technological feats to be accomplished with rather mundane problems, such as the materials' production by e.g. industrial microbiology, or fermentation. The planned use of rhodopsins, i.e. photosensitive proteins from microbes, for optoelectronic engineering, is a good example. In the 1980s, scientists started collaborating with Wacker Chemie, a German company that was among other things active in the silicon business, to pioneer such uses of rhodopsins. And whereas some seemed to think that such "molecular technology" might improve on then existing limitations of data storage or image processing, the first problems to be solved were production and purification of the substance on a relevant scale. The interest in rhodopsins should also be considered in light of biotechnological spirit of the time, as well as of political initiatives to foster the field in Germany after the development of recombinant DNA technologies in the US. Biotechnological production was considered an ecological alternative to the methods of the chemical industry, and uses of materials "designed by evolution" must have resonated well with the zeitgeist. Even if some

of the schemes to employ rhodopsins seemed to have worked in principle, and various actors were involved, most projects were abandoned in the early 1990s and none is successfully commercialized to this day. Though this failure presumably resulted from different factors, it may allow to analyze specific problems inherent to production and uses of biological materials for “nanotechnological” purposes. Rhodopsins were considered both sensory receptors of organisms and a material substance targeted for technologies on a molecular level. With hindsight, this combination of biophysical and biochemical research with material engineering and information technologies seems to fit under the umbrella of “nano-bio-info-cogno convergence” (NBIC) that has recently been put forward. Thus, the rhodopsin case allows to contrast the at times abstract and normative debates on this prophesized merger of sciences and technologies with an historical example of an attempt to transform a biological substance into a material technology.

Sacha LOEVE | Université Paris 1 Panthéon - Sorbonne, France

Point, line, plane: a trajectory of carbon

When modern chemistry emerged, carbon was viewed as an abstract, albeit material substrate underlying a range of phenomenologically simple and compound bodies. In this respect, carbon may be presented as an exemplar, a didactic tool illustrating the abstract mode of existence of chemical elements, as opposed to the concrete, empirical existence of simple substances. At least it was the way carbon wrote itself in chemistry textbooks and in metachemical attempts at defining the status of the element as that what persists through chemical transformations. But carbon continued to maintain and to compose other modes of existence, among which: carbon as the backbone of life and pillar of chemical industry (and of academic organic chemistry), and carbon as material. I will focus more specifically on the singular trajectory leading from carbon fibers to carbon nanotubes—a technoscientific renaissance in which carbon, pushed at the edge of the material, comes back into being as a menagerie of bizarre allotropes (nanotubes, fullerenes, graphene, and many more) all made up of pure surfaces, rolled, bent, folded or unfolded. As in Kandinsky’s system of basic figures making the world of painting (Point, Line, Plane), each one can be generated out of another: graphene can be rolled into tubes, fullerenes are capping the tubes, tubes can be opened to make graphene ribbons, and so forth. Carbon nanomaterials are no more defined by their elementary properties (“what is it?”), nor by their dispositions (“what are they capable of?”), but rather by their affordances: “what might they afford?” or “what might be performed with it?”—surfaces of affordance which generate a cornucopia of promises about high-tech applications as well as new research fields such as giant molecules or experimental 2-D physics. Finally, by considering the multiplicity of modes of existence of carbon, I will come back to the ontological question “what”, or rather “who is carbon?”

Commentary: **Nathalie JAS** | French National Institute for Agricultural Research, France

Discussion

Introduced and moderated by Pierre Teissier

S105. One hundred years of the Bohr atom

Sponsoring body:

DHST Commission for the History of Modern Physics

Mon 22 July, 11:10–17:40 ▪ Schuster Moseley

Symposium organisers:

Alexei KOJEVNIKOV | University of British Columbia, Canada

Helge KRAGH | Aarhus University, Denmark

Symposium abstract

2013 marks the centenary of the Bohr atomic model - the key event of the fundamental quantum revolution that has determined the characted of physics during the last century. Niels Bohr’s successful merger of new and strange quantum ideas with attempts to understand the microscopic structure of atoms, and its first experimental confirmations in the works by Henry Moseley, James Franck, and Gustav Hertz, will be the primary focus of the proposed symposium. It is more than fitting to celebrate the event in the city where Bohr and Moseley worked on their breakthrough discoveries. Analysing the process of knowledge production in Ernest Rutherford’s Manchester laboratory will help demonstrate how counterintuitive and revolutionary theories and instrumental practices emerge in conjunction with each other. Our second focus is on the spread of atomic quantum science internationally and its adaptation to other scientific cultures and traditions worldwide. The Copenhagen network of scientists exemplified the very possibility for internationalism in science during the troubled period between the two world wars. Its informal connections and traveling postdoctoral scholars allowed the representatives from formerly hostile European countries meet and collaborate on a neutral ground and helped disseminate atomic physics further, to North America and Soviet Russia, Japan and India, China and Brazil. The third major question we will be concerned with is the various (often incompatible) ways in which the strange quantum ideas got perceived, understood, and interpreted in these different national, social, political, and philosophical settings. Our hope is to reveal through this major example how science can function and be pursued as an international and at the same time a multicultural activity.

S105-A. Foundations

Mon 22 July, 11:10–12:40 ▪ Schuster Moseley

Chair: **Michael ECKERT** | Deutsches Museum, Germany

Finn AASERUD | Niels Bohr Archive, Denmark

Love and physics: Margrethe Nørlund and Niels Bohr’s scientific creativity, 1910-1913

Niels Bohr and Margrethe Nørlund were engaged in August 1910, less than a year before Bohr completed his doctoral work. Bohr then went to Cambridge and Manchester to continue his studies with J.J. Thomson and Ernest Rutherford, respectively. Niels and Margrethe married on Niels’s return to Copenhagen in August 1912. Bohr’s stay in England was an immensely creative period in his life, as confirmed by the intensive correspondence with his fiancée, who stayed behind in Denmark. The letters shed new light on this crucial period of Bohr’s career and document the importance not only of Margrethe, but also of his family in Denmark, for Bohr’s early development as a scientist and human being.

Helge KRAGH | Aarhus University, Denmark

Niels Bohr’s theory of atoms and molecules: anomalies and experiments

The theory of the constitution of atoms and molecules that Niels Bohr proposed a century ago was not motivated by specific empirical problems. Bohr was a theorist, not an experimenter. Nonetheless, he was much occupied, even obsessed with problems of an experimental nature and with confronting his theory to experimental tests. Not only did he follow relevant experiments closely, for a period he also engaged in spectroscopic and other experimental work himself. The development of the Bohr theory (or the Bohr-Sommerfeld theory), illustrates the fertility of a close connection between experiment and theory, and it also illustrates

the complex role played by empirical successes and anomalies in theory testing.

As is clearly shown by the declining phase of the old quantum theory, an anomaly is not just an anomaly. Anomalies may be given different weights, and not always for good reasons. Nor is a confirmation just a confirmation, witness that some of the most impressive confirmations of the theory (such as the Stern-Gerlach effect and the fine-structure spectrum) turned out to be spurious. While some anomalies were taken very seriously, others were more or less ignored, and others again were only recognized as anomalies *post factum*. In my presentation I argue that (i) to appreciate the status of quantum atomic theory in early 1925, one has to take into considerations not only the problems of the theory but also its successes; (ii) one has to extend and differentiate the list of anomalies as well as confirmations; (iii) the observability criterion was of much less importance to Heisenberg's *Umdeutung* than the correspondence principle; (iv) the sense of crisis in the physics community, and the revolutionary nature of the passage from the old to the new quantum theory, has often been exaggerated.

Dieter HOFFMANN | Max Planck Institute for the History of Science, Germany

Confirming Bohr's theory: quantum physics at Haber's Institute

Apart from playing a pacesetter role in transforming classical physical chemistry, preoccupied with electro- and thermochemistry, into chemical physics, focused on structure and later on dynamics, Haber's Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry made key contributions to early quantum physics, in particular to confirming Bohr's atomic theory. With the founding in 1919 of the department of physics and the appointment of James Franck as its head, the institute became a testbed for experimental quantum physics research. Among the topics tackled at the institute by Franck and his coworkers were electron scattering by gases as well as accurate spectroscopic measurements, which corroborated with precision the existence of the quantized energy levels foretold by Bohr's atomic theory. After Franck left for Göttingen in 1921, Haber's institute continued making key contributions to quantum physics through the pioneering work of H. Kallmann (confirmation of the Compton effect; development of the molecular beam method), K.F. Bonhoeffer and P. Harteck (separation of para-hydrogen), R. Ladenburg (lightscattering and dispersion), H. Kopfermann (nuclear multipole moments) and, last but not least, E. Wigner (the role of symmetry in quantum physics).

This presentation is based on work co-authored by Bretislav Friedrich.

Giora Hon | University of Haifa, Israel

The planetary model of the atom: Rutherford, Bohr and Sommerfeld

Ernest Rutherford's paper of 1911, which drew consequences from the experiments of Hans Geiger and Ernest Marsden at Rutherford's laboratory in Manchester on the scattering of alpha and beta particles by matter (1909), was a game changer. It established experimentally, irrespective of any theory or model, that the atom consists of a central charged mass surrounded by mostly empty space. Planetary schemes of the atom, which until then had been mainly qualitative, now seemed to be the "obvious" interpretation of these results, although Rutherford himself refrained from endorsing any of them. In 1913 Niels Bohr introduced an "atom-model" (his expression) with no explicit planetary analogy, but calling the path of the electron an "orbit" and identifying the axes of the ellipsoid of the electron as it rotates about the central core in stationary states. In 1915 Arnold Sommerfeld further developed Bohr's theory in which he presented a full blown planetary account of the atom, taking advantage of an analogy with Keplerian motion. Bohr accepted Sommerfeld's analysis and, in his Nobel Lecture of 1922, Bohr made it clear that, in his view, the chemical atom is essentially planetary. He was wrong. As is well known, by 1925 Bohr's quantum theory was replaced by quantum mechanics. In our talk we address the history of the

planetary model, with attention to the methodologies that were applied. We then consider the philosophical implications of this major episode that contributed to shaping physics in the twentieth century.

S105-B. Elucidations

Mon 22 July, 14:10–15:40 ▪ Schuster Moseley

Chair: Helge KRAGH | Aarhus University, Denmark

Michael ECKERT | Deutsches Museum, Germany

Extending the Bohr atom: the impact of Sommerfeld and his School on the rise of atomic theory, 1913-1919

Arnold Sommerfeld extended Bohr's model of hydrogen and hydrogen-like atoms by a more sophisticated scheme of quantization. In addition to Bohr's quantization of the azimuthal motion (angular momentum) of an electron around the atomic nucleus, Sommerfeld quantized phase integrals for the radial motion (allowing for elliptic orbits) and the orientation of the orbital plane (spatial quantization). Furthermore, he resorted to relativity theory which provided a theory of the fine-structure of atomic spectra. Thus he introduced a new fundamental constant -- "Sommerfeld's fine-structure constant" -- into physics.

Sommerfeld's elaboration paved the way for a broader research effort concerning atomic spectra and quantum theory. The effort started in Sommerfeld's Munich school, but it was soon carried further and involved physicists elsewhere--like Ehrenfest in Leiden, Debye in Göttingen, and Schwarzschild at the front during his service in World War I. The focus of this presentation is on the Munich circle of theorists as an early institutional centre of atomic theory, but this includes a study of how Sommerfeld's activities were perceived elsewhere. Thus it attempts to arrive at a closer insight into the mechanisms at work with the extension of Bohr's theory during the early stages of the path that led to quantum mechanics.

Alexei KOJEVNIKOV | University of British Columbia, Canada

The Copenhagen community: the fates of internationalism in post-World War I science

World War I destroyed the system of international competition / cooperation between the major scientific nations of Europe and America and inaugurated an era of chauvinistic manifestos, isolation, and academic boycotts that lasted more than ten years. Niels Bohr's Copenhagen Institute of Theoretical Physics provided an important but rare exception to the rule, by continuing internationalist commitments throughout the 1920s and creating one of the few places where scholars from hostile nations were encouraged to meet and collaborate. This paper examines the diplomacy, resources, and strategies that allowed Bohr to develop an international "center on the periphery" of European science, in a tiny country with limited possibilities.

1. Scandinavian internationalism. Denmark's neutral status allowed it to seek larger influence in world science by mediating between hostile greater powers. Sweden pursued a similar strategy via the Nobel prizes, while Denmark established a state foundation after WWI to fund its scientists' international activities. Bohr relied on it to invite the first foreign visitors to his institute, who mostly came from small countries of Northern and Central Europe.
2. American philanthropy. Bohr's contacts with the Rockefeller Foundation established with the help of the Danish diaspora resulted in a relatively small -- by Rockefeller standards -- but very timely institutional grant. The Foundation's first project to support European science after the destructive war also implied continuing investment in the form of IEB fellowships.
3. Postdoctoral revolution and hyperinflation. Unlike German research "schools," Bohr's institute attracted postdoctoral visitors from abroad, rather than PhD students. During the dire times of inflation, this new

career model for European scientists provided a much needed temporary substitute for the financially undermined position of Privatdozent at German universities and an additional motivation for up and coming scientists to come to Copenhagen.

4. Quantum Mechanics as Knabenphysik. The difficulties Bohr's own program of atomic physics encountered by the mid-1920s were resolved by a combination of new skills and training brought in by international visitors, such as Klein, Pauli, Heisenberg, Slater, Dirac, and later also Gamow, Landau, Rosenfeld, and others. The postdoctoral culture of doing science, nurtured by the Bohr Institute, culminated in a radical quantum mechanical revolution by 1927.

Seiya ARIKO | Independent scholar, Japan

Ishiwara's contributions to early quantum theory and the reception of quantum theory in Japan

My presentation consists of three sections.

§1 Ishiwara's original contributions to early quantum theory

Jun Ishiwara (1881-1947) was one of the earliest in the world and only one Japanese that contributed to early quantum theory. In 1911, he submitted his own original paper in German, 'Contribution to light-quantum theory', in which he deduced Planck's radiation formula from the viewpoint of radiation as a collection of light-quanta, to some extent, in a similar way to Bose's statistics of 1924. Also in that paper, Ishiwara tried to explain wave-like behaviour of radiation from that viewpoint, similarly to what de Broglie did by way of the phase wave in 1923. In 1915, Ishiwara published an original paper in German, 'The universal meaning of the quantum of action'. He criticized Bohr's quantum condition as that the scalar quantity h could not be the fundamental meaning of angular momentum, which is a vector quantity. Instead he extended Planck's quantum condition for systems with one degree of freedom that their phase space should be divided into equally probable regions of area h . Thus, he introduced his own quantum condition applicable to systems with many degrees of freedom. His 1915 paper, along with W. Wilson's paper of 1915, presented for the first time in the world, the quantum condition rendering Planck's radiation formula and Bohr's theory of atomic constitution at the same time. The difference between Ishiwara's and Wilson-Sommerfeld's quantum conditions is whether the symbol Σ , showing the summation over degrees of freedom, is put in front of the integral symbols or not. In 1917, Einstein criticized that Wilson-Sommerfeld's quantum condition, which lacked it, is not independent of the choice of coordinates.

§2 Reception of Early Quantum Theory in Japan

The reception of early quantum theory in Japan started in 1911, which was the year of the first Solvay conference on the subject of "Theory of radiation and quantum". Thus, it was not so much later than that in Europe. Nevertheless, compared with the reception of relativity in Japan, that of quantum theory was modest and limited to the world of specialists.

§3 Reception of Quantum Mechanics in Japan

In 1926, six young Japanese physicists started a new meeting for reading physics papers in turn. In the next year, they published Summary of Physics Papers Vol.1, which included expositions in Japanese of those papers by de Broglie, Schrödinger, Heisenberg, Born and Jordan, Dirac, et al. Also in 1927, a new journal in Japanese, Journal of Mathematico-Physical Society of Japan started, on every issue of which were printed abstracts of important papers, including those on newly built quantum mechanics. In December 1928, Sommerfeld visited to Japan, and made lectures on quantum mechanics. Late in that month, Yoshio Nishina returned home, who had been studying at Copenhagen under Bohr for six years, and derived famous Klein-Nishina formula for Compton scattering. Centering on Nishina's laboratory, research using quantum mechanics flourished in Japan.

Xiaodong YIN | Capital Normal University, China

Bohr's theory in China

In early 1920th, Niels Bohr and his work have been introduced into China, and the first paper about his work was introduced in *Wissen and Wissenschaft (XUEYI)* by Changshou Zhou in 1920. From 1920 to 1936, Bohr's theory about atomic structure and Copenhagen interpretation of quantum mechanics has been spread widely in China. In 1937, before the Anti-Japanese War, Bohr visited China and the grand reception gave him beautiful memory. Bohr's visiting China is very important for the history of China's scientific exchange. His speech was translated into Chinese and published in *Wissen and Wissenschaft (XUEYI)* in 1937. Bohr was evaluated as 'Thought leader of modern science', 'Pioneer researcher in atomic physics', 'One of the great physicist in the world' by Chinese scholars.

Niels Bohr was very friendly to new China since the establishment of People's Republic of China in 1949. Chinese scientific community also respected him. Prof. Gege devoted his life to introduce Bohr and his work into China. In 1985, on the occasion of the 100th anniversary of Bohr's birth, Chinese physics community held a ceremonious commemoration, and lots of Chinese physicists wrote articles which published in the next year to commemorate and highly praise Bohr. In this paper I comb the introduce and spread of Bohr's theory in China and analyse the articles written by Chinese physicists in 1986, the praise from all kind of area of research indicates that China accepted entirely Bohr's theory and praised it highly although his theory was ever criticized.

S105-C. Ramifications

Mon 22 July, 16:10–17:40 • Schuster Moseley

Chair: Shaul KATZIR | Tel Aviv University, Israel

Jeremiah JAMES | Max Planck Institute for the History of Science, Germany

Enduring methods from imperfect models: the Bohr Model and molecular physics

The Bohr Model became more than a pictorial representation and a handful of associated basic equations. It developed into one of the centerpieces of the network of mathematical models and practices defining the old quantum theory. It was the nexus around which physicists attempted to develop techniques for applying quantum theory to individual atoms and small groups of atoms. Results of these efforts were mixed, and the "failures" of the Bohr Model are central to almost every extant account of the development of quantum mechanics. Nevertheless, some of the strategies physicists developed in light of the Bohr Model turned out to be more resilient than the model itself and were reworked after 1926 for use with the new quantum mechanics. This appears to have been particularly important in the case of applying quantum theory to molecular structure, where methods leading to key results such as the Born-Oppenheimer approximation were clearly shaped by the capabilities and the limitations of the Bohr Model.

Daniela MONALDI | York University, Canada

Atoms in quantumland: from 'purely imaginary' Bose-Einstein condensation to macroscopic quantum phenomena

In 1924, Einstein predicted the occurrence of condensation in an ideal gas. This seemingly self-contradictory prediction derived from his application of Bose's statistical count of light quanta to an assembly of material particles. It appeared in print at the beginning of 1925, and was confirmed by the experimental production of the phenomenon, now known as Bose-Einstein condensation (BEC), in ultra-cold dilute gases in 1995. Although much happened in physics in the intervening seventy years, both theoretically and experimentally, physicists continue to describe matter as composed of elementary "building blocks", or particles, which they see as the modern version of atoms. At a deeper

level, however, the conception of atoms underwent a radical transformation. Explaining the aggregation of particles into complex systems—from the nuclear atom of Bohr's theory, to molecules, and to macroscopic solids and fluids—demanded an unsettling revision of the atomic model of matter that had enabled the adoption of statistical methods in the first place. In the words of the experimental discoverers of BEC, "atoms have lost their identity". The loss of classical identity is conceptualized as a result of the so-called wave-particle duality of quantum mechanics, and is manifested most strikingly in a group of laboratory phenomena, including BEC, which are named "macroscopic quantum phenomena". In this paper, I examine the early steps in the uneasy adaptation of the atomic model to the new understanding of the statistical properties of material particles, from the integration of Einstein's quantum statistics with the quantum mechanics of multi-particle systems to some key developments that led Fritz London to formulate the concept of macroscopic quantum phenomena.

Jeff HUGHES | University of Manchester, United Kingdom

How to kill an atomic theory

By the 1920s, the 'Rutherford-Bohr' atom was widely accepted as the orthodoxy in physics and chemistry. Of course, Rutherford and Bohr themselves, their students and co-workers and a growing international community of researchers continued to explore and refine the model through their experimental and theoretical work in atomic physics and radioactivity. Much of this work was controversial – for example the long-running controversy between Cambridge's Cavendish Laboratory and the Institut für Radiumforschung in Vienna over nuclear disintegration experiments, or philosophically-oriented debates about causality and complementarity. But no-one challenged the legitimacy of the Rutherford-Bohr model itself: indeed the emerging field of nuclear physics was predicated on it.

In 1933, however, a young English engineer produced an inverted 'alternative' to the Rutherford-Bohr atom in which a light nucleus was surrounded by orbiting heavy particles – a 'flywheel' model of the atom. He claimed that this alternative model offered significantly better insights into atomic behaviour and the bulk properties of matter, and successfully sought the attention of industrialists and the media as well as academics for his work. Amid heated controversy, claims of biased refereeing and stormy resignations, leading Cavendish physicists and their industrial contacts took the view that "the sooner this thing is killed the better." And kill it they did.

This paper explores the optimistic birth, chequered career and tragic early death of the 'alternative atom.' Its reception and fate – how it was killed – tell us a great deal about the nuclear physics community in the 1930s. Through the justifications they were forced to give for the orthodoxy, the episode also reveals much about what this community found valuable and useful about the Rutherford-Bohr atom. The paper concludes with some reflections on the implications of the 'alternative atom' story for nuclear historiography.

S106. Philosophy at work in modern physics

Sponsoring body:

DHST Commission for the History of Modern Physics

Tue 23 July, 09:10–17:40 • Roscoe 2.5

Symposium organisers:

Indianara SILVA | Universidade Estadual de Feira de Santana, Brazil

Aaron WRIGHT | University of Toronto, Canada

Symposium abstract

This symposium will explore physicists at work in the nineteenth and twentieth centuries doing what we recognize now as philosophy-metaphysical and conceptual work. Often, but not always, this was recognized as philosophical or "foundational" work by physicists themselves. This work blurs traditional disciplinary boundaries between physics and philosophy, and challenges the picture of modern physical science—particularly American science—as being characterized by an anti-philosophical pragmatism. The symposium will contribute detailed studies to a growing literature of technically- and philosophically-sophisticated histories of science, particularly physical science. Participants will ask questions such as: How did Helmholtz's empiricism play out in his laboratory? How was "classical physics" created alongside "modern physics" in optics? How did debates about the photon continue through post-war physics? How were concepts of time reconfigured in atomic clock making? What was "foundations of physics" in the twentieth century? And, how did logical concepts become physical concepts in the thermodynamics of computing? This symposium will contribute to creating a fruitful environment to discuss those questions and others through different historical and philosophical approaches.

S106-A

Tue 23 July, 09:10–10:40 • Roscoe 2.5

Chair: Thomás HADDAD | Universidade de São Paulo, Brazil

Massimiliano BADINO | Universitat Autònoma de Barcelona, Spain

How typical! High-probability arguments in mechanics, 1870-1931

The concept of typicality is nowadays a widely discussed way to deal with philosophical problems in statistical mechanics. Roughly said, it elucidates the coming about of equilibrium by showing that it is the "typical" outcome given normal mechanical conditions on the systems. In other words, it works as a high-probability argument to explain the observed behavior.

Historically, this was also the most popular use of statistical tools in mechanics at the end of the 19th century. Although Ludwig Boltzmann proved that the reach of thermal equilibrium is not an exceptions-free process (1872), he nevertheless claimed that its probability was overwhelmingly high. In so doing, he was sharply separating indeterministic processes from well understood probabilistic events. But, contrary to current philosophical reflections, typicality and high probability also showed up in mechanics with descriptive aims. In his ground-breaking work on the three-body problem, Henri Poincaré combined qualitative topological techniques with probabilistic tools to describe motions more complicate than the usual periodic trajectories deployed in celestial mechanics. This research led him to define typical trajectories as those that occur for all initial states with the possible exception of a set of states with measure equal to zero.

This tension between explanatory and descriptive functions of high probability arguments continued into the 20th century in the context of George Birkhoff's theory of dynamical systems and in his later ergodic theory (1931). This paper explores the use of high probability arguments in statistical and general mechanics and compares it with the modern philosophical concept of typicality.

Curtis FORBES | University of Toronto, Canada

Philosophies of science at work in nineteenth-century electrodynamic research

Electrodynamic research in the 19th century was surprisingly heterogeneous. Quite varied theoretical frameworks were developed and adopted by different researchers, and specific kinds of day-to-day research practices were associated with each of these frameworks. One question that arises for the explanatorily-oriented historian looking at this period is "why were their day-to-day laboratory practices so different?"

One answer, drawn from Buchwald's account (1993, 1994), is that the differences in laboratory practice resulted from the differences in theoretical frameworks, as the theory "came to life" in daily practice (1994, 19). While the theoretical differences between 19th century electrodynamics researchers do help explain the differences in their daily scientific practice, one would also like to account for the theoretical differences themselves. I argue that the theoretical differences between the three main research programs of the late 1870s—Helmholtz's in Berlin, Weber's in Göttingen, and Maxwell's in Cambridge—are best explained as the result of differences in the philosophical conceptions of science held by their main progenitors; in a manner analogous to the way that Helmholtz's representational practices "came to life" in his electrodynamics laboratory, for example, his distinctly empiricist conception of science "came to life" in his representational practices.

Marta JORDI TALTAVULL | Max Planck Institute for the History of Science, Germany

Negotiating the boundaries between classical and quantum physics before 1925

Ever since 1900, when Planck introduced the new universal constant "h" in the theory of radiation, physicists started to use it to account for physical phenomena, for whose explanation the theories of electrodynamics and mechanics inherited of the 19th century seemed not to suffice. From 1900 until 1925, physicists tried to incorporate "h" in the structure of electrodynamical and mechanical theories by tentatively supplementing them with "quantum" conditions. The problems originated by these attempts led physicists to be increasingly concerned about the relation between the emerging quantum physics and the classical body of knowledge: Was integration between the two ever-differentiating quantum and classical physics eventually possible, or a choice between both should be made?

Discussions on these fundamental questions rarely took place disconnected from the concrete physical problems one attempted to solve. In this paper, I will examine the different answers that Niels Bohr, Arnold Sommerfeld, and Rudolf Ladenburg put forward between 1910 and 1920, in the context of the explanation of optical dispersion. Contrarily to other physical phenomena more commonly discussed in the secondary literature, optical dispersion was consistently considered a paradigmatic example of the success of classical theories in accounting for the interaction between light and matter almost until 1920. Despite the increasing awareness of fundamental conceptual inconsistencies between the quantum postulates and classical physics during the 1910s, certain experimental features of optical dispersion could not be explained by the quantum hypothesis. How to deal then with this phenomenon? Should one seek for conceptual consistency in quantum theory, or should one trust old successful theories in this particular case?

Different answers were provided depending on different agendas. For Bohr a consistent quantum theory came first, at the expenses of explaining the physical mechanism. For Sommerfeld, instead, the classification of phenomena according to physical mechanisms was more important than full consistency. Finally, Ladenburg sought for an integration of optical phenomena through a common interpretation of experimental parameters over a detailed theory of the physical process. The physical characterization of dispersion was in each case different. The boundaries between quantum and classical physics were under negotiation, alongside the criteria to establish them.

Commentary: Suman SETH | Cornell University, United States

S106-B

Tue 23 July, 11:10–12:40 • Roscoe 2.5

Chair: Karl HALL | Central European University, Hungary

Olivia FREIRE JUNIOR | Universidade Federal da Bahia, Brazil

To what extent is philosophy relevant in the controversy over the interpretation of quantum theory?

Debates over the interpretation of quantum theory have evolved dramatically from the inception of the theory in the late 1920s to today. Before World War II, epistemology was part of the game in physics and the debates between Einstein and Bohr were considered quite naturally as part of the development of physics. After World War II these debates were revisited but given a new slant, namely that of a philosophical controversy, beyond physics, which did nothing to attract young physicists to work on the subject. Later, after Bell's theorem and professional changes in the status of foundational issues among the physicists in the early 1970s, the nature of debate changed once again and some hitherto controversial subjects became part of mainstream physics. The effective interaction between theory and experiments, which became current from the 1970s on, did not, however, eliminate the philosophical implications of this controversy, as can be seen from the proposal made by the physicist and philosopher Abner Shimony towards the development of an experimental metaphysics. Through a historical reconstruction of these debates we will see that even the lexicon of this debate was a controversial matter. Is there really a controversy? Is it philosophical or scientific? Answers to these questions were not independent of the characters and their projects. However, regarding the whole period under consideration, we will try to evaluate to what extent philosophy is ultimately responsible for the debates over the interpretation of quantum theory. Our conclusion is that in addition to epistemological and ontological issues, related to locality, realism, and separability, the history of these debates has brought to the history of physics a case of underdetermination of theories by empirical data. This is a thesis about the nature of science which was first suggested by Pierre Duhem and resumed by Willard Van Orman Quine. This conclusion, drawn from the history of these debates, has far reaching implications for the current practice of physics, its teaching, and its public image. We have termed it "an inconvenient truth" (Greca & Freire, 2013).

Indianara SILVA | Universidade Estadual de Feira de Santana, Brazil

A new light on the concept of the photon in the 1980s

The photon has become an important conceptual tool in current modern physics research related to quantum information and quantum computers. One might think that such a concept was settled through the theoretical and experimental achievements in quantum theory by the late 1920's. However, the history of the concept of the photon is not so linear as it seems to be. In 1956 the experiment carried out by the British Robert Hanbury Brown (1916-2002) and Richard Quentin Twiss (1920-2005), for example, put the 'traditional' concept of the photon in question, from which the photon was represented as a billiard-ball picture. After the theoretical developments proposed by the American Nobel Prize Roy Glauber (1925-), physicists started to discuss openly in the American Journal of Physics columns the meaning of the concept of the photon, trying to answer the questions – *What is a photon? Is it a particle? Is it a wave? What is it?* Another experimental result also contributed to the discussions on the photon concept in the 1980's. Such an experiment was performed by the French physicist Alain Aspect (1947-) and his research group who observed single-photons interferences, whose result was in agreement with the quantum description of the single-state photons. This article analyzes how physicists tried to answer those questions, considering their theoretical, experimental and philosophical arguments.

Alexander PECHENKIN | Lomonosov Moscow State University, Russia

The early ensemble interpretations of quantum mechanics in the USA and USSR

The paper is dedicated to the statistical (ensemble) interpretations of quantum mechanics which appeared in the USA and USSR before War II. The author emphasized a remarkable similarity between statements which arose in different social, economical and political contexts. The comparative analysis extends to the scientific and philosophical traditions which lay behind American and Soviet statistical interpretations of quantum mechanics.

The American movement was launched by the young and prominent physicist John Slater and his erstwhile teacher at Harvard, E. C. Kemble. The physicist and philosopher Henry Margenau, who with Robert Lindsay published the first American book on the foundations of modern physics, also pushed the ensemble approach. K.V.Nikolsky and L.I.Mandelstam were the main figures in the USSR. K.V.Nikolsky worked at Lebedev Physics Institute of the Academy of Sciences and, according to recollections and archival material, his quantum endeavors were supported by institute director S.I.Vavilov (who became President of the Academy of Sciences after War II). L. I. Mandelstam, professor at Moscow State University and one of the leaders of Soviet physics, presented his ensemble approach in his authoritative lectures in 1939. In the U.S. the ensemble approach was also proposed by Wendell Furry, while in the USSR it was supported by the Marxist philosopher B.M.Hessen, who took the command positions at the Moscow State University and Lebedev Physics Institute in 1930-1936.

There were cross references in the American writings. In fact, the young Slater attended Kemble's lectures on quantum mechanics and as a mature physicist he was planning to collaborate with Kemble in elaborating the foundations of quantum theory. The Harvard University Archives and the APS Archives show that Kemble and Margenau exchanged letters in 1935. In 1936 Furry stated the concept of ensemble by referring to the Kemble 1935 article. Although Nikolsky arrived at his ensemble approach independently from the Americans, he referred to Kemble in his 1941 book. After 1934 Nikolsky and Mandelstam both worked at the Lebedev Physics Institute and may have communicated. Mandelstam supervised Hessen's PhD work at the Communist Academy and subsequently Hessen was his administrative chief at the Moscow State University and the Academy of Sciences. The ensemble approach was touched in the addresses to the seminars which were held at the Moscow State University and the Communist Academy.

Commentary: Christoph LEHNER | Max Planck Institute for the History of Science, Germany

S106-C

Tue 23 July, 14:10–15:40 • Roscoe 2.5

Chair: Greg GOOD | American Institute of Physics, United States

Tilman SAUER | California Institute of Technology, United States

Heuristics and unified field theory in the 1920s

The program to formulate a unified theory of the gravitational and the electromagnetic field was widely shared by many theoreticians in the 1920's. The paper will discuss the motivation for this program and some of the approaches that were explored at the time. What was the aim of the program and what were the means that its proponents put to use in order to achieve it? Philosophical considerations about the characteristics of a perfect theory loomed large but were by no means the only factor that determined the unified field theory program.

Aaron WRIGHT | University of Toronto, Canada

Everything from nothing: John Archibald Wheeler's metaphysics of the vacuum

John Archibald Wheeler (1911–2008) was a consummate American scientist. Trained at Johns Hopkins, Wheeler was a nuclear physicist who contributed to the American atomic bomb and the post-war hydrogen bomb projects. He spent his career at Princeton, where, after the war, he transitioned to studying the physics of Einstein's theory of gravity—General Relativity.

This paper explicates Wheeler's metaphysics as it shifted during his years as a "relativist" using published and unpublished sources. I argue that Wheeler's thought was characterized by a philosophical drive toward the underlying roots and causes of things, characteristic of the philosophical tradition of Anglophone analysis. Wheeler's thought was also characterized by a delight in paradox, and a desire to progress through paradoxical formulations such as "mass without mass" and "charge without charge."

In 1953 Wheeler first proposed to consider the "view that only fields of zero rest mass should be regarded as fundamental": the electromagnetic field, the gravitational field, and the neutrino field. In 1955 Wheeler and his student Charles Misner discovered that in fact they could capture a complete picture of classical physics with only one zero rest mass field; the gravitational field. Here he was moving toward a view that the vacuum is fundamental, which he would express by 1956. This was the beginning of his thoughts that empty space may not be simply the arena for physics, but may actually constitute matter. Perhaps everything was really nothing.

Commentary: Helge KRAGH | Aarhus University, Denmark

S106-D

Tue 23 July, 16:10–17:40 • Roscoe 2.5

Chair: Daniela MONALDI | York University, Canada

John STACHEL | Boston University, United States

Meaning and measurement in modern physics

One important criterion for an acceptable physical theory is that its ontology and its epistemology be consonant: Namely, any concept defined within the theory as a physical observable should be accompanied by a prescription for its ideal measurement; and any limitations on the co-definability of a pair of such observables should be consistent with similar limitations on their co-measurability. Examples will be given from quantum mechanics, quantum electrodynamics, general relativity, and the search for quantum gravity.

Arianna BORRELLI | University of Wuppertal, Germany

The problem of 'naturalness' in high-energy physics from the 1980s to the discovery of the Higgs boson in summer 2012

Since the late 1970s the „Standard Model“ has been regarded as an eminently successful theory of particle phenomena, yet theoretical speculations on and experimental searches for physics beyond it have been underway for the last three decades, and one of the main motivations and guidelines for them has been the fact that the Standard Model, despite its empirical successes, displays features which the high-energy-physics community regards as „unnatural“. There were and still are many definitions of „naturalness“ in high-energy physics, but the general idea behind all of them is that a theory describing the inner workings of nature should not simply deliver consistent, correct predictions of phenomena, but should also do so without need of „fine-tuned“ computations (e.g. two very large numerical contributions almost cancelling each other to give a very small result) or large hierarchies of input parameters (e.g. the widely diverging masses of quarks). This „naturalness problem“ is neither an empirical anomaly nor a theoretical inconsistency, and physicists are ready to characterize it as an „aesthetic“ or „philosophical“ issue. Nonetheless, they regard it as a most serious flaw of present particle theory and a reason to believe in

the existence on „new physics“ beyond it. As the renowned theorist Mikhail Shifman recently put it: „The criterion of naturalness is aesthetic, or, if you wish, philosophic. If you do not like it you can ignore it. Most people like it“ (Shifman, ArXiv:hep-ph:1211.0004, 2012).

In my contribution I will sketch how the „naturalness problem“ emerged around 1980 to rapidly become a motor of theoretical and experimental research, from its first formulation by Leonard Susskind in 1979 to the doubts finally cast upon its significance by the discovery of the Higgs boson at the Large Hadron Collider announced in July 2012.

Commentary: **Alexei KOJEVNIKOV** | University of British Columbia, Canada

S107. Poincaré's *Méthodes nouvelles de la mécanique céleste* in historical context: bridging the frontiers of knowledge in mathematics, astronomy and wireless tech

Sponsoring bodies:

DHST Commission for the History of Modern Physics

ICHM: International Commission on the History of Mathematics (International Mathematical Union and DHST)

Wed 24 July, 09:10–12:40 ▪ Roscoe 2.5

Symposium organisers:

Jeremy GRAY | Open University, United Kingdom

Scott WALTER | University of Lorraine, France

Symposium abstract

Henri Poincaré's *Méthodes nouvelles de la mécanique céleste* (1892-1899) are known to have provided the basis for the emergence of 20th-century nonlinear oscillation theory and systems dynamics. Recently, Ginoux and Petitgirard noticed that as early as 1908, Poincaré initiated the modelling of current oscillations in the singing arc, a device proposed for the generation of wireless waves for telegraphy and telephony, using the same limit-cycle analysis he had developed in the *Méthodes nouvelles* to analyze the stability of planetary orbits. Previously, limit-cycle analyses of nonlinear current oscillations were thought to date from the late 1920s. Poincaré also investigated provocatively the topic of the stable shape of the Earth, not only theoretically in the 1880s but practically as a professional astronomer and as a senior figure in the French geodetic expedition to Peru in the early 1900s.

From an historical standpoint, Poincaré's innovations pose a number of questions about the reception of his mathematical techniques among the various communities of mathematicians, mathematical astronomers, mathematical physicists, electrical engineers, and geodesists. They also invite us to examine the history of research on continuous wave production, transmission and detection in the domain of wireless telegraphy: who was active in the field, what sort of problems were they facing, what were the constraints they were working under, what sort of material and cognitive resources were at their disposal, and under what circumstances? Similar questions can be asked about his work and its reception in theoretical and practical geodesy, that amplify the picture of French science at work in the years around 1900.

S107-A. Wireless technology and theory, 1896-1914

Wed 24 July, 09:10–10:40 ▪ Roscoe 2.5

Chair: **Jeremy GRAY** | Open University, United Kingdom

Elizabeth BRUTON | University of Leeds, United Kingdom

Singing arcs and oscillations: Henri Poincaré's contributions to British wireless developments in the early twentieth century

A re-evaluation of the work of French mathematician and physicist Henri Poincaré in early wireless developments was the subject of a 2010 paper by Ginoux and Petitgirard. [1] This scholarly study was centred on Poincaré's "forgotten" wireless telegraphy conference in 1908, in particular the mathematical equations produced by Poincaré which were required for the establishment of a stable regime of maintained oscillations in the singing arc, a form of wireless signal detection. The singing arc was initially developed as a form of electrical oscillator and lighting by English physicist, William Duddell, and was further adapted into the first wireless transmitter to produce continuous waves by Danish physicist Valdemar Poulsen. In this paper, I will trace the dissemination of Poincaré's publications on wireless including "Les Oscillations orie de Maxwell et les oscillations

hertziennes" (1899) in Britain and discuss how English translations of Poincaré's works became part of the accepted canon of wireless publications in Britain. I will further examine the influence of Poincaré's work upon British wireless pioneers with examples including Duddell and Oliver Heaviside. In conclusion, I will show that Poincaré's 1908 conference formed the keystone of his work in the formative years of wireless communications stretching from the end of the nineteenth century up to World War One and beyond.

[1] JEAN-MARC GINOUX and LOIC PETITGIRARD, Int. J. Bifurcation Chaos 20, 3617 (2010).

Scott WALTER | University of Lorraine, France

Poincaré's triple-dip cone: relativity, geodesics, and wireless technology at the St Louis World's Fair, 1904

At the turn of the twentieth century, Henri Poincaré (1854-1912) enjoyed an international reputation both as a scientist and as a standard-bearer for science. In these capacities, he served as president of the second International Congress of Mathematicians (ICM) held in Paris during the International Exposition of 1900, and as vice-president of the International Physics Congress, held shortly after the ICM. At the physics congress, Poincaré explained that the notions of space and time inherited from Newtonian mechanics had been arrived at in an arbitrary fashion, and could be replaced by any number of alternative dynamical schemes with no loss of predictive power. Four years later, Poincaré represented French science again, this time on U.S. soil, at the Congress of Arts and Sciences held in September 1904 during the Louisiana Purchase Exposition in Saint Louis. On this occasion, Poincaré launched a new critique of classical mechanics that underlined the conflict between Newton's third law and the principle of relativity, and envisaged in its place a "new mechanics", in which the speed of light in empty space could never be surpassed.

While scholarly studies of the World's Fairs and the events leading up to the theory of relativity are abundant, little has been made of the occasion offered by the World's Fairs of 1900 and 1904 for intellectual hybridization, via the concentration of multiple scientific congresses in a single place and time. The latter topic recently gained new interest, as far as the field of nonlinear electrical oscillations is concerned, when a neglected study by Poincaré in 1908 of the stability of such oscillations in the circuit of Duddell's singing arc came to light (Ginoux & Petitgirard 2010). Both Duddell and V. Poulsen attended the Electrical Congress in

St. Louis, along with Poincaré, who served as an Honorary Vice-President. Not only hybridization, but self-cultivation as well was on display, for example, when Poincaré availed himself of insights drawn from his treatise on "Les méthodes nouvelles de la mécanique céleste" for his lecture in St. Louis on the geodesics of convex surfaces, that built on earlier work by Jacques Hadamard.

Rapidly-unfolding developments in wireless technology and advanced mathematics such as these were followed closely by Poincaré, who recognized in them the potential to open up new research horizons. In short, an in-depth study of the contexts of Poincaré's World's Fair lectures stands to illuminate the origins of relativity theory, systems dynamics, and the emergence of the modern scientific worldview.

Commentary: Graeme GOODAY | University of Leeds, United Kingdom

S107-B. Early applications of Poincaré's *Méthodes nouvelles* in celestial mechanics and mathematics

Wed 24 July, 11:10–12:40 • Roscoe 2.5

Chair: Tilman SAUER | California Institute of Technology, United States

Frédéric BRECHENMACHER | Université d'Artois & Ecole polytechnique, France

The algebraic cast of Poincaré's *Méthodes nouvelles*

Poincaré's approach to the three body problem has often been celebrated as a starting point of chaos theory in relation to the investigation of dynamical systems. Yet, Poincaré's strategy can also be analyzed as molded on - or casted in - some specific algebraic practices for manipulating systems of linear equations. These practices shed new light on both the novelty and the collective dimensions of Poincaré's *Méthodes nouvelles de la mécanique céleste*. As the structure of a cast-iron building may be less noticeable than its creative façade, the algebraic cast of Poincaré's strategy is broken out of the mold in generating the novel methods of celestial mechanics. But as the various components that are mixed in some casting process can still be detected in the resulting alloy, the algebraic cast of the *Méthodes nouvelles* points to some collective dimensions of Poincaré's methods.

Jeremy GRAY | Open University, United Kingdom

Testing Newton's mechanics: Poincaré on geodesy

In the 1880s Henri Poincaré did important work on the shape of the Earth regarded as a stably rotating mass of fluid. This led him into a correspondence with the younger Russian mathematician Liapunov, that revealed important differences in their attitudes to rigour in mathematics, and in what it meant for mechanical systems to be stable. In the years after 1900 Poincaré was also heavily involved in the direction of the French geophysical expedition to Peru to measure longitude, and when that concluded he became interested in the motion of the tides and ocean currents. This mixture of often highly innovative work and attention to his patriotic duty provides a revealing insight into the life and work of one of France's leading mathematicians and scientists.

Philippe NABONNAND | University of Lorraine, France

Why did Poincaré study geodesics of convex surfaces?

In 1905, Henri Poincaré published in the Transactions of the AMS a paper about geodesics of a convex surface. Poincaré motivated the study of geodesics of surfaces with positive curvature by the proximity of

this problem with the three body problem. In particular, Poincaré stressed the analogy of closed geodesics of this kind of surfaces with periodic solutions of the three body problem.

The aim of this talk is to understand why Poincaré chose this way ; we will stress the links of this paper with preceding works of Poincaré, specially his qualitative theory of differential equations and his new methods of celestial mechanics.

Tatiana ROQUE | Universidade Federal do Rio de Janeiro (UFRJ), Brazil

Poincaré's new methods in the field of celestial mechanics of his time: relations with Hill and Gylden

In recent research on the reception of Poincaré's methods in celestial mechanics, I have formulated the conjecture that the "new methods" referred to in the title of the famous book of Poincaré was part of a strategy to connect himself with the field of celestial mechanics. One of the main pieces of evidence was that there were other names known as practitioners of "new methods." Thus, I suggest that, although Poincaré made new contributions, his intention was not merely to label his own methods as "new"; he was seeking rather to promote the so-called new methods and to gain acceptance in the field.

When one investigates the writings of important actors of this context, it is noticeable that a great number of them speak of new methods associated with the names of Hill and Gylden. It is known that Poincaré substantially used Hill's approach in formulating his own methods and that Gylden reacted negatively to the prize Poincaré won. The relationship between these individuals, all of whom were recognized as innovators, is however more complicated. Starting with their published papers, I propose to analyze the differences and similarities in their methods and how they were received by astronomers until the very beginning of the 20th century.

One of Poincaré's propositions most efficiently used by contemporary astronomers involves the determination of periodic solutions in the restricted three-body problem, which starts with a known closed orbit and investigates the effects of perturbations. This practice is related to a method Gylden disseminated some years before, that of Intermediate Orbits. On the other side, Poincaré's developments are based on another way of treating these orbits, proposed by Hill in 1877 but only known in Europe after 1886. The renewal of interest in Hill's methods probably has to do with the popularity of Gylden. Yet, it was Hill's approach that led Poincaré to consider Gylden's methods as outdated: Gylden's methods have only historical interest, stated Poincaré and other commentators after him.

This brief account shows how much this episode deserves to be reexamined, and it is an important part of understanding the network into which Poincaré desired to insert his works in celestial mechanics.

S108. Knowledge at work in the oceans of the world

Sponsoring bodies:

DHST Oceanography Commission

DHST Pacific Circle Commission

Mon 22 July, 11:10–17:40 • Roscoe 1.010

Symposium organisers:

Walter LENZ | Institute of Oceanography, University of Hamburg, Germany

Vera SCHWACH | Nordic Institute for Studies in Innovation, Research and Education, Norway

Symposium abstract

When historians turn seaward the view include not only the coastline, but also the ocean which for a large part is not discernible by men directly. Thus ships, machines, gears, tools, instruments and skills have been critical for the attempts to understand the conception of the sea. Science was - and is- of critical significance as a way of knowing the sea, and the technologies used by scientist mediated crucial knowledge about the ocean. The contributors to the Symposium will through their cases-studies examine the importance of some of the tools and the methods used in the field studies on the ocean, in order to deepen the overall understanding of scientific practice and scientists at work.

S108-A. Observers and instruments

Mon 22 July, 11:10–12:40 ▪ Roscoe 1.010

Chair: Walter LENZ | Institute of Oceanography, University of Hamburg, Germany

Loïc PÉTON | Université de Bretagne Occidentale, France

Georges Aimé (1810-1846), an observer of the Mediterranean Sea

In 1843, the naturalist Edward Forbes (1815-1854) exposed to the British Association in Cork his conception of a life limited at a depth of 300 fathoms (550 meters) in the Aegean Sea. At the same year, Georges Aimé (1810-1846), a French professor of physics in the small Algerian College, started to write his book entitled 'Exploration scientifique de l'Algérie pendant les années 1840, 1841, 1842 – Physique générale' (Paris, 1845). In the first volume, he describes his own observations and experiments in the Mediterranean Sea near Alger. In contradiction to an "antibiotic view", Aimé wrote that he had found "zoophytes" at depth between 1400 and 1800 meters.

Furthermore, Aimé made some interesting physical observations on Mediterranean Sea, like Alger's tides, sea temperature, sea currents, waves and others. By his own means, he invented new instruments to study and investigate the unknown depths of the sea. Among them, there were tools to quantify the depth: a sounder release device, a reversing thermometer, an instrument for determining current, a bottle to sample deep water, etc. He used these instruments on board a small boat "at my own risks".

In 1846, he started new experiments in Alger "which the results interested together zoologists and geologists" as said the naturalist Henri-Milne Edwards (1800-1885). Unfortunately, Aimé would die in that same year, after a fall from a horse at only thirty-five years-old.

Despite of being the most part of the time an independent observer and researcher, Aimé had some important contacts with French scientific institutions. Thus, he was correspondent of the Académie des Sciences and also member of the French scientific commission created to explore the new French colony, Algeria. Furthermore, the influential physicist François Arago (1786-1853) helped him to get a position of "sedentary observer" in Alger in 1837.

Despite his innovative work, Aimé was unrecognised during and after his short life. After his death, the French war ministers appealed repeatedly to the Académie that the Aimé's unpublished manuscripts must be studied, but nothing was done.

The aim of this paper is to set the original work made by Aimé in context, to identify the supports that allowed his work and to try to understand how so innovative work was forgotten in his own time.

Vera SCHWACH | Nordic Institute for Studies in Innovation, Research and Education, Norway

At sea with science, at work with water samplers: the importance of instruments in oceanography, 1890-1920

A comprehensive understanding of how marine science materialized should include studies on the development of theories, scientific practice and instrumentation. This paper argues that Scandinavian scientists came in forefront around 1900, due to the breakthrough of the theory of dynamic oceanography, but also owing to the emphasis put on fieldwork partly under extreme conditions, technical skills and a joint Scandinavian effort to define international standards for instrumentation and measurements. The case study covers Pettersson's insulated waterbottle (ca. 1890); the Pettersson-Nansen bottle (ca. 1900) and The Nansen-Ekman bottle (ca. 1905), the last one became a standard instrument for sampling sea water until 1980.

Precise measurements of the salinity and temperature at specific depth are crucial to obtain accurate oceanographic data. Around 1890 numerous watersamplers were in use, but no common standard for samplings and measurements was established. The Swedish chemist and scientific entrepreneur Otto Pettersson (1848–1941) and the Norwegian zoologist, explorer and oceanographer Fridtjof Nansen (1861–1930) belonged to a group of Scandinavian, marine scientists fervently working to have their instruments and salinity methods set as international standard. The International Council for the Exploration of the Sea (ICES) (established in 1902) with its regular and coordinated surveys, became their principal channel of influence.

The paper examines the strong efforts by which Scandinavian scientific theories, methods and technology were spread to the United Kingdom, Germany, Canada and the USA – but not to France. Despite France's renowned universities, advanced marine stations and its link to Monaco, a hotbed of oceanographic studies owing to the abundant patronage of Prince Albert I of Monaco (1848–1922), the country made few contributions to oceanography until the 1960s. One motive for the disinterest may have been national pride; another explanation is Julien Thoulet (1843–1936), a dominant oceanographer in this period. He dissuaded the dynamic oceanography, considering complex mathematical modelling and interpretation as a fruitless way to understand the ocean conditions. Thoulet also rejected the watersamplers developed by the Scandinavians and constructed his own. Despite a substantial marine scientific community and the national efforts France did not succeed in developing a distinctively improved, different scientific concept of the ocean.

Artur SVANSSON | University of Gothenburg, Sweden

Oceanographic instruments: Walfrid Ekman's repeating current meter and its use at deep-sea, 1930

Walfrid Ekman (WE) was during ICES first years 1902-8 employed at its Central Laboratory (CL) in Norway. He was in this period very active in writing theoretical articles, as well as constructing instruments. In 1905 he described a propeller current meter (CM), where small balls, directed by a compass, fall into compartments.

When ICES in 1908 closed its CL, WE returned to Sweden where he was appointed Professor of Theoretical Physics at the University of Lund. During his Norway years he had met Björn Helland-Hansen (HH) then working in Bergen/Norway. The two families met and many letters were exchanged. The contact was then nearly none before 1919, from when it grew more and more up to WE's death in 1954. Common oceanographic cruises on Norwegian 'Armauer Hansen' were carried out. In 1924 HH tested WE's Repeating CM at sea with good results. Sverdrup et al. (1942) describes it shortly:

"In this instrument (WE 1926) the propeller is released and stopped by messengers. When the propeller is stopped, three numbered balls are released from a container. One ball drops down into a compass box, giving the direction of the current at the time the propeller was stopped, and two balls are guided into other slots by the position of dials turned by the propeller. From the slots into which the balls fall, the positions of the dials can be found and thus the number of revolutions of the propeller can be obtained. The messengers are designed to split when they strike

the instrument, and the two parts are caught in a container. The operation can be repeated forty-seven times, when the store of numbered balls is exhausted."

I'll give a Power Point Presentation including most of the figures of WE (1926) in demonstrating this CM. A map of the sea area west of Gibraltar will show the sites of June-August 1930 current measurements at stations A-F, deepest at E of nearly 4.000 meters and longest at D of 141 hours.

Commentary: Roy MACLEOD | University of Sydney, Australia

S108-B. Expeditions

Mon 22 July, 14:10–15:40 ▪ Roscoe 1.010

Chair: Vera SCHWACH | Nordic Institute for Studies in Innovation, Research and Education, Norway

Johan VAN BENNEKOM | Royal Netherlands Institute for Sea Research, Netherlands

The science of the oceans at work on the oceans

During my 35 years of chemical analyses on board, research ships changed from sample collectors to versatile laboratories. For dissolved chemicals like Cl- and O2 standardized methods by titration had been developed already before 1900; for major nutrients determined by colometry this occurred from the 1930's onwards. The ICES played an important role in dissemination of the methods as well as in intercalibration programs to make results of different laboratories comparable with ever increasing accuracy.

In the 1960's plastic bottles became available for sampling deep waters, and, together with new methods for trace elements, most metals could be analyzed. All naturally occurring elements on the planet have now been found in sea water. For many elements involved in biological processes (e.g. major nutrients but also Fe, Mn, ...) one wants to know seasonal and regional variations down to very low levels, nanomolar concentrations. This requires ultraclean working conditions, difficult onboard ships. Many types of investigations are easier in laboratories in standardized sea containers and nowadays research ships have ample places to connect these containers with the water and energy supplies. Not only for ultraclean work, but also for precise temperature control and for walk-in fridges, containerized laboratories are simpler to construct than rebuilding the ship's interior.

Widespread use of CTD-sensors in the last quarter of the 20th century changed measurements of salinity from chemical to physical properties. This means – with necessary attention for accuracy – that salinity can be reliably measured with an extra decimal. The two decimals, attainable previously allowed to describe the deep circulation in the ocean in general terms. The third decimal opens the possibility of a new field of research: trends in salinity changes, which, together with temperatures could predict subtle changes in the circulation due to climatic change.

These new techniques not only increased the scope and accuracy of marine chemistry, but also the speed of obtaining results on board. Interpretation and even publication can start at sea; preliminary papers being sent by e-mail. Seagoing research changed fast, but also the stress increased: the equipment has to work and more specialized technicians are in the crew.

New equipment like submersibles, both manned and remotely operated created completely new subjects: deep-sea vents with their unheard-of living communities. Sensors attached to buoys, anchored to the sea bottom give seasonality of the measured properties. New vehicles and new detection methods are in general developed in research areas with hardly limited budgets like space, defence or health, but adapted for use in oceanography.

Cornelia LÜDECKE | University of Hamburg, Germany

German echo-soundings of the south Atlantic seabed, 1938-39

Aside from its primary aim of using two aircraft to carry out an extensive aerial photogrammetric survey of the unexplored hinterland of Dronning Maud Land, the Third German Antarctic Expedition of 1938-39 aboard *MV Schwabenland* also collected numerous meteorological and oceanographic measurements during its voyage to and from Antarctica. Among the newest scientific equipment available for this short summer campaign was an underway echo-sounder to map the depth of the seabed, allowing the crew to escape from the tedium of stopping to take soundings with a lead-line. *Schwabenland* was one of the first three scientific research vessels to use echo-sounding to map the sea floor of the South Atlantic, the others being the *Meteor* (1925-27) and the *Discovery-II* (from 1930 onwards). *Schwabenland's* soundings were the first to discover submarine channels that form the heads of Antarctic submarine canyons. *Schwabenland* also made the first axis-parallel bathymetric profile down a mid-ocean ridge, displaying its rugged nature; confirmed the existence of a median rift in the South Atlantic branch of the mid-ocean ridge; and discovered that the floor of the South Polar Basin was more or less flat, a characteristic later recognised as typical of abyssal plains. It took years to realise the full significance of the echo-sounding profiles. The expedition's geographer, Ernst Herrmann, was a geologist with expertise in volcanic studies. He interpreted the mid-ocean ridge, apparently for the first time, as a continuous volcanic structure. Although he was right about the ridge being made of basalt, he was wrong about the details of the ridge's formation. In any case, he got no credit for his imaginative proposal, mainly because it was published in German in his travel account. In honour of the expedition, a South Atlantic seamount was named after the ship, and four Antarctic submarine canyons were named after the ship, the expedition leader Alfred Ritscher, the leader of the echo-sounding team Ernst Herrmann, and after the ship's ice pilot Otto Kraul.

This presentation is based on work co-authored by Colin Summerhayes.

Hauke BIETZ | Independent scholar, Germany

The Danish deep-sea expedition of the *Galathea II*, 1950-1952: results and epistemological traces

The Danish Expedition of the "Galathea II" around the world brought important results concerning the marine organisms in the deep sea. Furthermore it represents an open Danish nation to the world. The "Galathea II" showed not only different organisms of the Abyssal but for the first time of the deepest trenches of the western Pacific. The Fahrleiter Anton Bruun coined the term Hadal for the region below the Abyssal under 6000 m.

Although the "Galathea II" aimed to investigate new deep sea regions beside the routes of former expeditions and to widen the horizon of knowledge relating marine organisms the technical equipment and the methodological approach had partly been developed earlier. Some crew members made experiences on other Danish cruises. Therefore the expedition of the "Galathea II" is part of a long tradition. On an epistemological level there are different scientific, methodological, social and financial aspects that influenced the expedition. Roots can be found in preceding deep sea expeditions like those of the British "Challenger", the German "Valdivia" and the Swedish "Albatross" but especially in Danish cruises of the "Dana I" and "Dana II" some years before. Therefore the cruise of the "Galathea II" showed the world what lives at the bottom of the oceans but the results derived from the abilities of the crew, the comprehensive tradition in Denmark, the international scientific experience and simply the luck to grap with the net at the right time on the right places.

Erik DÜCKER | Radboud University Nijmegen, Netherlands

The pioneering investigations of Paul Regnard (1850-1927) into the physiological demands on organisms in the deep sea

The second half of the nineteenth century saw a significant rise in the interest in the natural history of the deep sea, in part triggered by the Challenger Expedition. This resulted in a change in awareness of the importance of the oceans, which is excellently illustrated by the work of pioneers such as French physiologist Paul Regnard, and notably by his 1891 book "Recherches expérimentales sur les conditions physiques de la vie dans les eaux". This paper focuses on the much-neglected work of this physiologist.

As a student of Paul Bert (1833-1886), Regnard had studied the effects of air pressure on various terrestrial animals, and through his friendship with Prince Albert I of Monaco (1848-1922), he was drawn to questions regarding life in the oceans. When he was given the opportunity to study the effects of hydrostatic pressure in the laboratories at Sorbonne and Le Havre, he focused on the investigation of the effects of hydrostatic pressure on terrestrial life forms so as to assess the physiological adaptations required for life at depth in a marine environment.

Regnard's work covered an array of experiments which documented the unusually intimate relationship of marine organisms with the medium in which they lived. Familiar physiology was found to fail at pressures found at depths of 4,000 meters, where yeast became latent and muscle tissue failed to respond to electrical stimuli. It was thus evident that deep sea life required significant physiological adaptations.

Regnard criticized the neglect of interest into these physiological adaptations, which ignored the importance of marine life on this planet. Like other nineteenth-century naturalists, he drew attention to the general discrepancy between biologists' interest in terrestrial and marine life. Although the latter constituted the main domain of life, it was barely understood and rarely investigated.

The figure of Regnard sheds light on the alternating fortune of deep sea biology throughout its uneven history. The general tendency to understand biological phenomena from a terrestrial point of view has been repeatedly interrupted by an awareness of this bias. While Regnard's work represents a high point in this awareness, the relative historical obscurity into which his work has fallen illustrates the subsequent decades' declining interest in deep sea biology. This repeating pattern of alternating biases deserves our attention, as a general trait of the history of modern deep sea biology.

S108-C. On the interpretation of in-situ data

Mon 22 July, 16:10–17:40 ▪ Roscoe 1.010

Chair: Cornelia LÜDECKE | University of Hamburg, Germany

Marcel WERNAND | Royal Netherlands Institute for Sea Research, Netherlands

Globe-wide response of ocean colour to climate change over the last twelve decades

Marine primary productivity is an important agent in the global cycling of carbon dioxide, a major 'greenhouse gas', and variations in the concentration of the ocean's phytoplankton biomass can therefore explain trends in the global carbon budget. Since the launch of satellite-mounted sensors globe-wide monitoring of chlorophyll, a phytoplankton biomass proxy, became feasible. Just as satellites, the *Forêt-Ule* (FU) scale record (a hardly explored database of ocean colour) has covered all seas and oceans - but already since 1889. We provide evidence that changes of ocean surface chlorophyll can be reconstructed with confidence from this record. Our analysis has not revealed a globe-wide trend of increase or decrease in chlorophyll concentration during the past century; ocean regions have apparently responded differentially to changes in meteorological, hydrological and biological conditions at the surface related to global warming. Since 1889 chlorophyll concentrations have decreased in the Indian Ocean and in the Pacific; and increased in

the Atlantic Ocean, the Mediterranean, the Chinese Sea, and in the seas west and north-west of Japan. Clearly, explanations of chlorophyll changes over long periods should focus on hydrographical and biological characteristics typical of single ocean regions, not on those of 'the' ocean.

This presentation is based on work co-authored by Hans van der Woerd and Winfried Gieskes.

Natascha ADAMOWSKY | University of Freiburg, Germany

Visualising the uncertain: William Beebe's *A Half Mile Down*. Epistemological-aesthetical thoughts on the construction of a submarine space of knowledge using the example of deep sea exploration

Scientists reflect on the experience of 'blindness' in regard to the unknown and assimilate their experience in forms of texts and images in very different ways. Questions of visualisation are highly important for research practice. When William Beebe, protected by a 1,50 diameter ball, the *bathysphere*, in 1934 turns out to be the first to reach a depth of 923 meters, he suffers from a glaring 'visual defect'. The images of the deep-sea world produced according to his indications mirror the ambivalent process of forming representation, which gradually assimilates maritime life to the requirements of scientific research practice.

Based on the Beebe example, I would like to speak about the specificity of submarine knowledge space and the change of visualisation styles of deep-sea creatures. Every epistemic space is without doubt the result of constructive processes, but the sea especially increases the 'blind spots' of scientific practice: we are dealing with an extrahuman area which we can only access with help of technologies and media – a fact already mentioned by Keith Benson, Helen Rozwadowski and David van Keuren in their very important book on oceanographic research, "The Machine in Neptune's Garden" (2004). Accordingly, images *of or from* the depth of the sea are by definition effective images, but they also produce knowledge that would not exist without the above-mentioned media based visual process.

Walter LENZ | Institute of Oceanography, University of Hamburg, Germany

On the understanding of plankton blooms in the North Sea: from single-net catches to 3D-dynamical computer simulations

Phytoplankton (unicellular algae) is the fundamental source of life in the sea. This perception was established more than one-hundred years ago by the German Victor Hensen (1835-1924), physiologist at the University of Kiel. He was especially interested to quantify the productivity of fishing areas. The first step was to catch plankton and he started with a modified butterfly net. Then, he organized simultaneous catches by ships of different organizations in northern Germany, which were coordinated on a national level by the Kiel Commission since 1870 and later internationally by the International Council for the Exploration of the Sea (ICES), founded in 1902. The results of these investigations in the following decades brought the understanding of how the food web/metabolism functions in the sea and how it is influenced by certain factors – physical, chemical and biological.

Whereas limnologists did understand these processes already in the late 19th century, marine plankton modeling started only in the midst of the 20th by G.A. Riley (1911-1985), director of the Institute of Oceanography at Dalhousie University/Halifax, together with the physical oceanographer H. Stommel (1920-1992) of Woods Hole Oceanographic Institution and followed by the mathematician J.H. Steele of Aberdeen's Marine Laboratory.

1970, in the frame of a multidisciplinary marine research program at the University of Hamburg a project was initiated to develop applications of

hydro-numerical methods for quantitative reproduction and prediction of physical-chemical-biological processes in the sea. In order to get ground-truth data, a 100 days data set was collected by an international and multidisciplinary experiment, which was conducted 1976 at the Fladenground in the northern North Sea, called FLEX'76. The crucial results will be presented.

This presentation is based on work co-authored by Guenther Radach.

Commentary: [Roy MACLEOD](#) | University of Sydney, Australia

S110. Homemade science: domestic sites and the gendering of knowledge

Sponsoring body:

DHST Commission on Women and Gender Studies

Wed 24 July, 14:10–17:40 • Roscoe 2.3

Symposium organisers:

[Donald Luke OPITZ](#) | DePaul University, United States

[Brigitte VAN TIGGELEN](#) | Independent scholar, Belgium

Symposium abstract

As a robust area for investigating the production of scientific knowledge, the geography of science has been dominated by places like the field, laboratory, marine station, museum, and civic lecture hall. But scientists among these diverse sites uniformly must retire to one common place: the home. How might our accounting of the geography of knowledge-production shift when we add this fundamental institution to the work-lives of scientists? In what ways did the home provide spatial, material, and social resources for the pursuit of science, and how was “homemade science” produced in perhaps distinctive and yet replicable ways? How might the home have spawned distinctive gender meanings and dynamics in knowledge-production? What were the statuses of domestic sites within broader geographies of science?

In this symposium, speakers have been invited to address these questions by examining the status of the domestic production of science in a range of time periods, locations, disciplines, and physical configurations. Individual presentations will pay particular attention to how the gendered meanings and dynamics of scientific work assumed particular forms within domestic settings, and what those forms entailed for scientific outcomes. A commentator for the symposium, as a whole, will draw lessons from the individual cases to suggest how, collectively, the contributions push our historical understanding of the geography of gendered knowledge production.

S110-A

Wed 24 July, 14:10–15:40 • Roscoe 2.3

Chair: [Donald Luke OPITZ](#) | DePaul University, United States

[Staffan BERGWIK](#) | Uppsala University, Sweden

The scientific home in transit: circulating a gendered family life in early twentieth-century physics and chemistry

The argument of this paper is that laboratory-based physics and chemistry in the early twentieth century were deeply connected to the circulation of a particular form of gendered family life. The paper will present how domestic sites facilitated the intermingling of scientific and

family life in the international community of scholars. The empirical example is the Swedish physical chemist Svante Arrhenius and his wife Maja Johansson. They married in 1905 and subsequently created a scientific household at the Nobel Institute for Physical Chemistry in Stockholm. Repeatedly, they visited similar scientific sites abroad. This paper aims to display how scholars transferred a culturally intelligible way of family life. Frequent travelling migrated a gendered lifestyle throughout the international community. Everywhere, husbands and wives were expected to perform distinct duties and, repeatedly, scholars discussed the fate of their children.

The paper argues that the circulation of a gendered way of life was not external to knowledge making, but foundational to laboratory practices. A legitimate and culturally intelligible lifestyle produced trust, support and kinship needed for collaboration. So far, this dimension of knowledge in transit has not been addressed in the history of science, albeit processes of migration have been a repeated topic of concern in the field. Finally, the paper also suggests some major shifts in science and family life as Sweden was modernized in the twentieth century. These transformations will be indicated by a short description of the fate of the Arrhenius couple's children.

[Brigitte VAN TIGGELEN](#) | Independent scholar, Belgium

Agnes Pockels: the shaping of a ‘*forschende Hausfrau*’

When offered access to research facilities at the University of Göttingen by the infamous professor Woldemar Voigt in 1893, Agnes Pockels (1862-1935) politely declined, arguing her housewife duties didn't allow her to move out of her household where she was required to take care of her frail parents. Two questions immediately arise from this. How did a housewife gain such scientific credibility and authority as to be invited to pursue her research in one of the best academic settings in Germany? And how can one explain her choice to continue her scientific investigations at home, whereas the access to an academic facility should have been perceived as the ultimate achievement for a young woman who had been excluded, like all her female contemporaries, from advanced education after the age 15?

In this paper, we will deal with these questions and examine how Agnes Pockels herself shaped her scientific practice inside the household, not only materially by using the kitchen sink and domestic appliances to study surface films on water, but also by choosing to take on another calling that was more in line with the expectations for German (single) women.

[Helen Anne CURRY](#) | University of Cambridge, United Kingdom

Garden biotech: amateur experimental biology in the twentieth century

Although gardens frequently appear in historical accounts as important sites of scientific (or natural philosophical) research and practice through the 19th century, they are only rarely encountered in the literature on 20th century science. This is true even of botanical gardens, which once counted among the foremost sites of scientific exchange and knowledge production, let alone the more humble home or domestic garden, which was never accorded as significant a position to begin with. In this paper I return attention to the garden, and particularly the domestic garden, as a site of interest for historians of 20th century science and technology. I will present a study of the activities of amateur flower and vegetable breeders, a varied group of practitioners united in this study by their interest in applying genetics research to their efforts to develop new varieties of plants. In their attempts to adopt and adapt new tools and techniques drawn from genetic science – methods ranging from hybridization to the application of mutagenic agents – these amateurs turned their flower and vegetable gardens into experimental venues and undertook genetics experiments as leisure time activities.

As I argue in this paper, this study of experimental science and a domestic space encourages us to reconsider two common assumptions found within the literature of twentieth century science. The first is a narrative of twentieth century biology in which amateurs are assumed to have been excluded from experimental biology – as opposed to natural historical studies, where amateurs and professionals frequently interacted, sharing materials and methods. In the case of amateur plant breeding I describe, it becomes clear that experimental practices were not so exclusionary as has been assumed; some professionals encouraged amateur activities (one even going so far as to turn his amateur correspondents' gardens into an extension of his laboratory) and others objected to them, but in either case they recognized a shared set of tools and practices. The second is the gendering of do-it-yourself science and technology as an activity undertaken primarily by men and boys, often with the intent of displaying or defending masculinity. Amateur plant breeding does not appear to have followed a similar trajectory as these other amateur traditions, with women participating much as men; this offers the possibility to reconsider the assumed role of gender in amateur science and technology.

Carol MORRIS | University of Nottingham, United Kingdom

Contemporary amateur meteorology, gender relations and the shaping of domestic masculinity

This paper focuses on amateur meteorology as a particular type of 'homemade science' since the production of meteorological data and knowledge takes place primarily within domestic spaces. A growing body of scholarship has begun to explore the history of amateur meteorology and this will be drawn upon to frame the paper. However, our primary interest is contemporary forms of amateur meteorology which have not received much research attention in spite of (mostly social scientific) scholarship which examines the ways in which amateur / volunteer science organisations are being recognized as legitimate sources of environmental knowledge within the design, implementation and evaluation of environmental plans and policies. More specifically, questions of female involvement and gender relations within amateur meteorology have also tended to be overlooked. By drawing on interviews with members of one of the most important amateur meteorological networks in the UK - the Climatological Observers Link - this paper seeks to address this gap. The research identifies a predominantly male bias within amateur meteorology in the UK, offers insight into why and how this bias has emerged and explores the implications of this bias for gender politics in the home. It also considers the way in which, as a pursuit that is very much situated within the domestic sphere, amateur meteorology complicates traditional framings of the home as a female realm and contributes to what we identify as a domestic masculinity.

S110-B

Wed 24 July, 16:10–17:40 ▪ Roscoe 2.3

Chair: Brigitte VAN TIGGELEN | Independent scholar, Belgium

Julie DAVIES | University of Melbourne, Australia

Botanizing at Badminton House: the botanical pursuits of Mary Somerset, first Duchess of Beaufort

Over a period of more than thirty years Mary Somerset, Duchess of Beaufort, devoted a substantial portion of her time and wealth to botanical pursuits on a grand scale. Indeed, by the turn of the eighteenth century, Mary had amassed one of the largest and most varied botanical collections in England. The collection was particularly renowned for the extensive range of exotic plants which included both a large array of local flora and specimens from as far away as southern Africa, Barbados, Canada, and Japan. Yet, the Badminton estate remained the primary site of Mary's knowledge production throughout her life and this

paper will explore the opportunities and challenges this locale created for Mary's scientific endeavours. In particular, I will consider the extent to which the Badminton estate, Mary's relationship to it, and social limitations on female botanizers impacted her capacity for botanizing and the outcomes of her pursuits. On the one hand, Mary's status and wealth were central to her ability to establish the far reaching networks which in many ways transcended both the boundaries of Mary's gender and her home in regard to knowledge and specimen acquisition. On the other hand, both the grounds and the people associated with the Badminton estate enabled Mary to receive, catalogue and coordinate, process and preserve the intellectual and physical material necessary for her work. Thus, this case of gentlewomanly botanical practice shows how both local and transcendent factors intermingled in the gendered production of botanical knowledge.

Katy PRICE | Queen Mary, University of London, United Kingdom

Radio death and radio widows

During the early-mid 1920s, stories about radio appeared in British pulp fiction magazines. These stories display various possible masculine roles through the intervention of radio in domestic life: the tyrannical husband, the thwarted lover, the obsessed hobbyist, the criminal bachelor, the rejected step-father and the new husband. Taking advantage of genre fluidity during this period, the stories mix science fiction with romance, crime and adventure plots.

In this paper I offer the pulp stories as an alternative narrative of radio masculinity to that seen in popular wireless magazines and books of the period. The pulp narrative is one that has more flexibility than those more expository and celebratory works: through the conventions of genre fiction, male authors are able to explore fears about the disruptive presence of radio in the home, in both satirical and moralising modes. I conclude with some questions about the uses of popular fiction as a resource for accessing non-elite experiences of science and technology. Who are the pulp authors speaking for - their readers, the magazine owners, or themselves? Whose interests do their fictions serve? To what extent does popular fiction subvert or reinforce the messages of expositors?

Claire G JONES | University of Liverpool, United Kingdom

Discovery on the edge? The tensions of 'domestic science' in the work of Hertha Ayrton and Henderina Scott

The amateur versus professional distinction in science arguably became more acute in the decades up to 1900 and during the first years of the twentieth century. This was a time when the production of science moved to a mainly institutional setting, and when specialisation and fragmentation led to the creation of new scientific societies for whom the 'professionalism' of their membership or fellowship was often a signifier of status. Gender added another dimension to the amateur/professional dichotomy and to the meanings ascribed to knowledge produced in the domestic space.

Physicist and electrical engineer Hertha Ayrton (d. 1923) and botanist and film-maker Henderina Scott (d. 1929) both pursued their scientific research in a domestic setting. Ayrton won a Royal Society medal for her research and was the first woman to be nominated for a Royal Society Fellowship in 1902. Scott, who pioneered slow-motion films of plant growth, became one of the first 'Lady-Fellows' of the Linnaean Society in 1905. Both women can be understood as working at the periphery of the Royal Society and their science, to some extent, was accepted and valued by London's masculine scientific elite. Despite this, contemporary understandings of their work were coloured by the domestic space of its production and the sex of its producer.

This paper will explore the ways in which gendered assumptions about the domestic influenced meanings ascribed to the scientific work of Ayrton and Scott. These meanings connected to issues of trust, credibility and status; they also impacted on the kind of research that

these women were able to engage in. The tension created by Ayrton and Scott's domestic spaces of experimentation is clear in contemporary representations of them and their work; it is also evident the acceptance (or otherwise) of their home-made science by London's man-made scientific institutions.

Paul WHITE | University of Cambridge, United Kingdom

Darwin's house of science

It is well known that after 5 years travelling the globe, Darwin worked almost all of his life from home in the quiet village of Down in Kent. His work seems to fit well within the tradition of gentlemanly science that persisted in Britain well into the second half of the nineteenth century, using the house and its environs as a site of observation and makeshift experiment, reliant upon family members for assistance, and personal networks of exchange, especially letter writing.

The home is often viewed as a pre-modern space of scientific practice, or as a centre of 'popular' science in the modern period. As such it is juxtaposed to more impersonal and mechanized institutions of teaching and research that emerge in conjunction with the modern state, and eventually predominate over the course of the 19th century. Darwin's richly documented working life challenges these assumptions and juxtapositions, while bringing into focus what is perhaps a more telling feature of domestic science, namely the role of the affections in the production of knowledge. Darwin's work shows the enduring importance of the home in the making of elite science in the late 19th century. The Darwin household, with its team of assistants, chain of command, and battery of research programmes pursued over decades shares features usually identified with state science; while Darwin himself acquires many of the characteristics of an institution, occupying a stable centre of authority, directing the research agendas of others, and authoring a stream of publications based upon work by remote observers, collectors, and collaborators, a community of work bound not, however, by bureaucratic allegiance or professional obligation, but by emotional ties: familial love and friendship, adoration, reverence, and mutual respect.

Commentary: **Donald Luke OPITZ** | DePaul University, United States

S111. Geography and its publics

Sponsoring bodies:

History of Geography Inter-Union Commission
(International Geographical Union and DHST)

History and Philosophy of Geography Research
Group of the Royal Geographical Society

Wed 24 July, 09:10–Thu 25 July, 12:40 ▪ Uni Place
1.219

Symposium organisers:

Jacobo GARCÍA-ÁLVAREZ | Universidad Carlos III de
Madrid, Spain

Heike JONS | Loughborough University, United Kingdom

Symposium abstract

This conference symposium focuses on the theme of 'Geography and its publics'. Throughout its history, geography has been utilized to serve wider political, economic, social and cultural interests. Modern nation states, for example, employed cartographers to document geographical features as a basis to information for statistical intelligence and military operations. In the nineteenth century, business and government interests supported the foundation of geographical societies for the co-ordination of exploratory projects, reports of whose work often enthralled or enraged the general public. Since the institutionalisation of geography

at the end of the nineteenth century, audiences for geographical knowledge have multiplied and diversified, reflecting a growing awareness of the production and application of geographical knowledge.

This conference symposium brings together scholarship on the nature of geographical knowledge in relation to geography's publics as it is discussed in nine countries on four continents. The symposium is organised around three sub-themes of two sessions each, namely 'Multiple publics', 'Geopolitics and exploration', and 'Geographical education and knowledge'. These sessions address a range of private and public workplaces in which geographical knowledge has been made and used as well as other settings, formal and informal, in which geography has been communicated to the wider public, mainly to shape people's geographical imaginations and understanding. Key questions address the utility of geographical knowledge, the processes and practices that transfer geographical knowledge between different epistemological realms, the nature of a public for geography, and the wider impacts of geographical knowledge on society.

S111-A. Multiple publics, part 1

Wed 24 July, 09:10–10:40 ▪ Uni Place 1.219

Chair: **Jacobo GARCÍA-ÁLVAREZ** | Universidad Carlos III
de Madrid, Spain

Keynote

Charles WJ WITHERS | University of Edinburgh, United
Kingdom

Missing the point? Capturing geography's public in historical context: questions and examples from the nineteenth century

Historians and sociologists of science and others have long recognised the difficulty of identifying in detail who made up the category 'public', perhaps especially in historical context. Whether the category 'the public' is understood in terms of affiliated groups (public relations theory) or in terms of the ambiguous 'public sphere', whether we deal with audience numbers or with reviews as indicative of a subject's intended public, whether we deal with 'popular science' or with different models of cultural competence and the public understanding of science, the object in question - the public - seems always to escape fine-grained analysis. This paper will explore these issues with reference to several examples from the geographies of nineteenth-century science, looking at questions of audience, public response and public review in the meetings of the British Association for the Advancement of Science, and at the identification of an eponymous public and the idea of 'public interest' in debates between 1871 and 1884 around a single Prime Meridian for the world. If it is the case that understanding the analytic category 'the public' is contingent upon the object or scale of our enquiries, does this matter?

Commentary: **Mike HEFFERNAN** | University of
Nottingham, United Kingdom

Simon NAYLOR | University of Glasgow, United Kingdom

Weather observatories and their publics in the nineteenth century

The formation of the Meteorological Department of the Board of Trade in 1854 helped to cement meteorology's usefulness to the British nation and particularly to shipping. Later it invested in land-based observatories, which were meant to contribute to the development in weather forecasting for those living and working on land. However, arguments for the value of meteorological science to various publics - indeed, the very invention of meteorology's publics - began much earlier than the mid-nineteenth century. This paper considers the justifications that were made for the study of the weather at sea and on land in the first half of the nineteenth century, and the attempts that were made to

put these in place. In doing so it follows the establishment of routines for weather observation on board military and commercial ships as well as plans to observe the weather at colonial observatories. The paper then considers the publics that these meteorological schemes were meant to assist. These were divided into numerous groups, some of which were geographical bounded. In turn the paper attempts to consider where and how meteorology was engaged with by its users – in short, the paper asks who meteorology's publics actually were and where they were to be found.

Christina DANDO | University of Nebraska-Omaha, United States

The other *Hull House Maps*: geography, cartography and Progressive Era women's activism

The beautiful ethnographic maps published in *Hull-House Maps and Papers* (1895) have long been heralded as one of the first social surveys of its kind in the United States and for their unique design. But Hull-House continued to produced studies with maps in the decades following. In addition to the Hull-House ethnographic maps, Chicago women used maps in their campaign for suffrage, for temperance, and as part of their campaigns to improve the living conditions in Chicago. During the Progressive Era (1890-1930), women activists wielded geography and cartography to advance their social agendas on a variety of fronts. Using the example of Chicago, this paper will examine the ways in which geography and cartography were used by activist women as part of their campaigns to improve living and working conditions in their communities.

Geography and cartography have long been associated with masculinist ways of knowing the world. These Chicago examples of women's mapping represent the adoption of geography and cartography as part of women's social work, carving out a public women's space focused on issues that transcended the public/private divide, such as public sanitation, public schools, and tenement conditions, and applying scientific methods of social service and geography. Through their employment, women activists were presenting their arguments using the language and tools of science and politics, terms that those in power would understand.

In addition to the studies and maps generated, I will also explore Chicago's collaborative network of women activists, who were often involved simultaneously in multiple campaigns. For example, Anna Nicholes was active with the Neighborhood Settlement House, the local and national suffrage movements, and the Women's Trade Union League. Through settlement organizations, city clubs, local and national suffrage organizations, temperance organizations, progressive organizations (such as trade unions and organizations) and education institutions, women from a wide variety of stations and experiences worked for change. By focusing on this network of active women, I will attempt to delineate how these women adopted and adapted geographic knowledge and created knowledge and maps for their own purposes.

S111-B. Multiple publics, part 2

Wed 24 July, 11:10–12:40 ▪ Uni Place 1.219

Chair: Jan VANDERMISSEN | Université de Liège, Belgium

Heike JONS | Loughborough University, United Kingdom

Geographies of British university expansion in the 1960s

In Britain, the 1960s are widely regarded as the decisive decade for the postwar expansion of British universities. Prominently marked by the publication of the Robbins Report on Higher Education in 1963, this period saw a significant increase in the number of universities, full-time university students, and public expenditure per student. Paradoxically, seven new 'plateglass' universities had already been approved by 1961,

the year the Robbins Committee was set up, while university expansion after 1963 focussed on the upgrading of existing institutions to independent universities. This paper uses previously unexamined documents in the UK National Archives to analyse the debates that informed the governmental decisions about founding seven new universities in Brighton (Sussex), Norwich (East Anglia), York, Canterbury (Kent), Colchester (Essex), Coventry (Warwick) and Lancaster from 1958 to 1961. Particular attention is being devoted to the geographies of this process by examining first, how the government's locational decisions changed the geography of both UK higher education and wider society; and second, to what extent geographers and geographical knowledge contributed to public debate and governmental policy about British university expansion before the publication of the Robbins Report.

Jean Louis YENGUÉ | Université de Tours / UMR CITERES, France

Les services écosystémiques et la gestion du territoire: l'apport de la géographie

La notion de services rendus par les écosystèmes (SES) apparaît dans les années 70 dans un rapport du MIT intitulé *Study of Critical Environmental Problem*. Elle s'est diffusée dans la sphère académique à compter des années 80 via des auteurs tels que Westman (1977) qui parle de nature's services mais surtout à partir de l'article de Ehrlich et Mooney (1983) intitulé « Extinctions, substitutions and ecosystems services » (Boisvert, Vivien, 2010). L'objectif est alors de souligner la dégradation des écosystèmes par les activités humaines. Mais c'est le Millenium Ecosystem Assessment (MEA) impulsé par Kofi Annan en l'an 2000 qui a véritablement popularisé la notion (à l'image du rapport Brundland en 1987 pour le Développement Durable) à compter de la parution du rapport en 2005. Les auteurs y présentent 4 grands types de services : (i) Les services d'approvisionnement (produits agricoles, bois, eau potable, poissons etc.) (ii) Les services de régulation (climat, inondations, purification de l'eau...) (iii) Les services culturels (aspects esthétiques, religieux, récréatifs) (iv) Les services de soutien, qui constituent la base des 3 autres types de service (Grands cycles géochimiques, formation des sols) (MEA, 2005). A partir de là, trois grands domaines de recherche sur les SES peuvent être distingués: (i) L'analyse biophysique du fonctionnement des écosystèmes et les bénéfices directs aux sociétés humaines, (ii) l'évaluation économique des SES, (iii) les paiements aux services environnementaux (Barraud et al, 2011). La méthodologie à employer pour quantifier ses SES (Salles, 2010) est quant à elle à inventer. Il est maintenant accepté qu'ils imposent une démarche pluridisciplinaire, tant les disciplines qui s'y sentent concernées sont nombreuses. Dans cette contribution, par l'exemple de l'étude des SES, nous nous intéresserons d'une part à la place de la géographie dans une démarche pluridisciplinaire qui impose une hybridation des démarches et non une superposition des pratiques disciplinaires, d'autre part au rôle du géographe dans le transfert des résultats d'une telle recherche vers les gestionnaires (élus locaux, etc.). Nous nous sommes appuyés sur deux programmes de recherche dont nous sommes à l'initiative et dont nous avons la charge du pilotage : CESAT (Vers une gestion durable des sols-support des espaces verts : Maintien et développement des fonctions et services. Exemple de l'Agglomération Tourangelle) financé par le ministère français de l'environnement et SERVEUR (services écosystémiques des espaces verts urbains) financé par la région Centre. Les premiers résultats, qui pointent le rôle de liant et de facilitateur du géographe, seront développés lors de la communication orale.

Sarah MILLS | Loughborough University, United Kingdom

Surprise! Public historical geographies, user engagement and voluntarism

This paper aims to expand understandings of 'public geographies', not usually associated with historical geography, through considering voluntarism. It seeks to bring together debates on research practice,

romain rendait indispensable, aux yeux de Strabon, un changement de gouvernement, car « il serait difficile d'exercer un aussi vaste pouvoir autrement qu'en en confiant l'usage à un seul homme, considéré comme un père » (*id.* VI,4,2).

Le souhait de Strabon fut-il exaucé ? Sa *Géographie* fut-elle utilisée par les gouverneurs de province ? Bien fin qui le dirait. Ce livre fut achevé sous le règne de Tibère, qui mit fin aux espoirs suscités par l'administration d'Auguste. Publié probablement en Asie Mineure, la patrie de l'auteur, il ne semble guère avoir influencé l'élite romaine. Il n'en est pas moins un précieux témoignage sur les intentions d'un géographe qui se voulait au service du gouvernement.

Manoel Fernandes SOUSA NETO | São Paulo University/CAPEs, Portugal

The 1867 Luso-Brazilian covenant: collections, maps and institutions

The 1867 Luso-Brazilian's Covenant has allowed an exchange of maps and memories that has resulted in the formation of two major cartographic collections, essential to both countries and to several territorial policies undertaken by the respective States. The maps choice, the process of letters reproduction, the later use of the cartographic collections, implies in the understanding of the collections assembly from their purposes for which they were intended from the beginning. The best-known result of the Covenant has been the formation of two map libraries too much important for both countries. For Portugal, the maps that came with D. John VI to Rio de Janeiro in 1808 and returned after the exchange, have served to initiate the collection of current Portugal's Geographic Institute. For Brazil, letters and memoirs have served to shape a collection that would be the basis on which would be structured the Itamaraty Map Library. A careful analysis of how Duarte da Ponte Ribeiro has chosen the maps in more than one Portuguese file, and the way of doing it favouring the problems related to the Brazil Empire's frontiers with the neighbouring countries, gives the clue to the understanding of which were the purposes of this choice that were put through from the first approaches made by the Brazilian diplomat, until the beginning of the negotiations for the covenant establishment, which has been developed from the year of 1863 until the year of 1867. The exchange, however, does not concern only the maps that the Brazilian diplomacy have wanted to bring from Portugal, but concerns in an effective way of that was offered to the Portuguese government and it could be useful in the production of a more accurate chart of the kingdom like that one performed by Filipe Folque - the man at the other border of the covenant - to the lusitanian territory administration policies and to the frontier disputes with Spain. The weaving process of the covenant, their purposes not always cleared by both countries, the different characters involved in it, the technical cartographic processes developed and the results obtained for some specific issues such as the maps production based on the letters collection drifted by the covenant are, in our sight, examples that can clarify the relationship between: the cartographic knowledge contained in those collections, diplomacy and territorial policies put through on both sides of the Atlantic.

Aldo D'AGOSTINI | Independent scholar (PhD in Aix Marseille Université, 2010), Italy

La publicisation de la géopolitique française par le biais de reportages de voyage: le cas du journaliste Gabriel Charmes (1850-1886)

Au cours du xix^e siècle, la diffusion de nouveaux moyens de transport et de communication (bateau à vapeur, chemins de fer, télégraphe, etc.), et la mise en place d'une série d'innovations technologiques et sanitaires (acier, câbles sous-marins, quinine, etc.) poussent les États à changer leurs façons d'exercer le pouvoir dans l'espace géographique (geo-power). En même temps, l'exploration et l'occupation systématique de territoires extra européens fait surgir une nouvelle représentation du globe. Celui-ci apparaît désormais comme un système complexe d'espaces fermés, la plupart occupés par des États européens ; les

autres objet de leurs disputes. Dans ce contexte, se développe une nouvelle forme de savoir, la géopolitique, qui peut être définie comme un ensemble d'efforts intellectuels visant à expliquer la signification et le fonctionnement du nouveau ordre mondial (cfr. Ó Tuathail, 1996). Avant de se fixer dans des discours et dans des théories spécifiques, comme celles de Mackinder ou de Kjellén, la pensée géopolitique se développe d'abord auprès des classes dirigeantes des grands Empires coloniaux européens qui sont en quête de nouveaux outils conceptuels pour planifier leurs politiques expansionnistes. En cette même époque, ces mêmes classes dirigeantes doivent faire face aux défis liés au développement du système parlementaire et à la diffusion de la presse politique. Elles doivent notamment tenir compte des humeurs de l'opinion publique et fabriquer des discours capable de justifier, entre autres, les choix de politique étrangère. Ceci les pousse à donner de la publicité à leurs idées géopolitiques qui, en effet, se prêtent à devenir des puissants instruments de propagande. À travers la presse et l'activité de quelques publicistes proches des milieux gouvernementaux, la pensée géopolitique se vulgarise et se fixe dans l'imaginaire des classes moyennes sous la forme d'une série d'images et représentations. Le journaliste français, Gabriel Charmes, auteur de nombreux reportages sur la Méditerranée et personnage très proche des milieux gouvernementaux de la III^e République (son frère était ministre plénipotentiaire au quai d'Orsay) constitue un excellent exemple pour étudier ce genre de phénomène. Dans ses écrits, Charmes vulgarise et publicise les idées stratégiques qui animent la politique étrangère de la France, notamment pour ce qui concerne l'expansion en Afrique (occupation de la Tunisie) et la politique méditerranéenne (relations avec l'Empire ottoman). Pour cela, il n'hésite à fabriquer des métaphores et des images suggestives qui lui permettent de donner une représentation assez riche et fascinante de l'espace géopolitique méditerranéen. Il contribue ainsi au développement d'une rhétorique et d'un imaginaire géopolitiques fonctionnels à la politique impérialiste du gouvernement.

Larisa ALVES DE LIRA | Universidade de São Paulo, Brazil

A unificação da Península Itálica e a unidade da Península Ibérica segundo Vidal de la Blache. Uma visão sobre a liberdade da política estatal d

O século XIX é um século de transformações profundas. Não apenas os Estados estão em pleno processo de formação (como a Itália e a Alemanha), como a economia global ensaia seus primeiros passos. Marie Claire Robic especifica como o movimento da civilização do século XIX, ancorado na extrema mobilidade, produziu em Vidal de la Blache uma impressão de descontinuidade "revolucionária". Este sentimento de mobilidade e transformação marcou o pensamento dos intelectuais, Vidal aí incluído. O essencial, para efeito deste artigo, é perceber como este contexto produziu em Vidal a impressão de que os obstáculos que o meio geográfico impunham às civilizações podiam ser superados pela vontade humana, a partir deste momento. Vidal de la Blache, historiador que fora, projeta o seu determinismo para períodos mais longínquos da história, sendo marcado pela idéia de que, no presente, as civilizações são marcadas pela superação de dificuldades históricas. O caso da península itálica e ibérica é exemplar neste sentido. Pois mesmo os estados atrasados, nesse raciocínio, acumularam energias para superar os particularismos políticos locais logrando constituir-se como um Estado Nacional. A discussão sobre a liberdade que os homens podiam exercer na política, na literatura geográfica, é tema de controversas. Segundo alguns autores, os geógrafos franceses deram pouca atenção aos fenômenos políticos no seu campo de atuação. Outros procuram realçar o aspecto central da política nos intelectuais que, inclusive, estão envolvidos no projeto colonial de alguns países no século XIX. Lacoste pretendeu realçar o caráter geopolítico do pensamento de Vidal através da análise da concepção de nacionalidade esboçada em La France de l'Est criando uma dualidade entre o Vidal dos gêneros de vida, do Tableau de la Géographie de la France e dos Principes de Géographie Humaine, e o Vidal da geopolítica, de La France de l'Est. No entanto, há outro livro, no qual apoiamos as análises desse trabalho, em que as concepções

políticas de Vidal aparecem em toda sua magnitude. Assim, acreditamos que o livro *États et Nations de l'Europe* é o primeiro e precoce manual de Geografia Política de Vidal. Para efeito deste trabalho, o essencial é demonstrar que a concepção política de Vidal é pautada sobre a liberdade da ação sobre o meio geográfico e isso se expressa nas análises de Vidal sobre a unificação da Península Itálica e a unidade da península ibérica no bojo do século XIX.

L'unification de la péninsule italienne et l'unité de la péninsule ibérique selon Vidal de la Blache: une vision de la liberté politique de l'État au XIXe siècle

Le XIXe siècle est un siècle de transformations profondes. Non seulement des États sont en train de se constituer (comme l'Italie et l'Allemagne), mais aussi l'économie mondiale fait ses premiers pas. Marie Claire Robic montre comment le mouvement de la civilisation au XIXe siècle, qui se caractérise par la mobilité extrême, provoque chez Vidal de la Blache une impression de discontinuité « révolutionnaire ». Ce sentiment de mobilité et de transformation a marqué l'esprit des intellectuels, y compris Vidal. Notre but, dans le cadre du présent travail, est de comprendre comment ce contexte a produit chez Vidal l'impression que, désormais, les obstacles imposés par le milieu géographique pouvaient être surmontés par la volonté humaine. Vidal de la Blache, l'historien qu'il était, projette son déterminisme sur des périodes plus lointaines de l'histoire; il est marqué par l'idée que les civilisations peuvent, alors, surmonter les difficultés historiques. Le cas des péninsules italienne et ibérique est exemplaire à cet égard. Puisque selon ce raisonnement même les États les plus arriérés ont accumulé l'énergie nécessaire pour vaincre les particularismes politiques locaux et se constituer comme des États-nation. Dans la littérature géographique, le débat sur la liberté que les hommes pouvaient exercer en politique est un sujet controversé. D'après certains auteurs, les géographes français ont prêté peu d'attention aux phénomènes politiques dans leur domaine. D'autres ont voulu souligner la dimension centrale de la politique chez les intellectuels, qui sont même impliqués dans le projet colonial de certains pays au XIXe siècle. Lacoste a cherché à mettre en évidence la dimension géopolitique de la pensée de Vidal à travers l'analyse de sa conception de nationalité, qui a été esquissée dans *La France de l'Est*. Il a créé, ainsi, une dualité entre le Vidal des genres de vie, du *Tableau de la Géographie de la France* et des *Principes de Géographie Humaine*, et le Vidal de la géopolitique, de *La France de l'Est*. Il y a pourtant un autre ouvrage, sur lequel nous appuyons notre analyse, et dans lequel les conceptions politiques de Vidal apparaissent dans toute son ampleur. Ainsi, nous pensons que les *États et Nations de l'Europe* est le premier manuel - œuvre précoce - de géographie politique de Vidal. Dans le cadre de cette étude, il nous intéresse de montrer que la conception politique de Vidal est guidée par la liberté d'action humaine sur l'environnement géographique et que cela s'exprime dans ses analyses de l'unification de la péninsule italienne et de l'unité de la péninsule ibérique, en plein XIXe siècle.

S111-D. Geopolitics and exploration, part 2

Wed 24 July, 16:10–17:40 • Uni Place 1.219

Chair: Charles WJ WITHERS | University of Edinburgh, United Kingdom

Diarmid FINNEGAN | Queen's University Belfast, United Kingdom

Religious imaginaries and missionary geographies in late-Victorian Britain

In July 1872, Sir Bartle Frere – Vice President of the RGS and elder statesman – provided, under the auspices of the Christian Evidence Society, a rebuttal of the argument that Christianity was 'little suited to men of other races and climates'. Taking Frere's apologia for Christianity as a civilizing agent and 'bond of political union' as a starting point, this paper examines how this essentially geographical postulate was expressed in the rhetoric propagated by British missionary societies and their supporters. The paper analyses material from missionary handbooks, biographies, periodicals, atlases and other geographical literature, to better understand how Frere's position was maintained and modified across a wide spectrum of missionary opinion. More generally, the paper investigates the relationship between specific religious imaginaries and particular imaginative geographies evident in the pervasive but varied efforts by Victorian Britain's missionary enthusiasts to argue for, and enact, Christianity's presumed universal reach.

Sarah EVANS | University of the West of England, United Kingdom

'She meant to be a serious explorer': the popular reception of women's expeditionary work, 1913-1939

In this paper I will use case studies drawn from my ongoing PhD research, into women's involvement with Royal Geographical Society (RGS)-supported expeditions between 1913 and 1970, to explore the popular reception of their expeditionary work. Whilst women's past expeditionary work, in common with women's past geographical work more broadly, has until recently been comparatively overlooked within the history of geographical thought and practice, and within understandings of expeditions as epistemological spaces and practices (Maddrell 2009; Rose 1993), at the time of their expeditions many of these women were well-known public figures, achieving popular fame and recognition on the basis of their published popular accounts of their expeditionary work, and the lectures that they gave to institutions such as the RGS, semi-public spaces. Some of these works continue to attract popular audiences today, as do biographies of the women in question. This trend was a continuation of the tremendous public appetite for accounts by women travellers associated with the careers of earlier women travellers such as Isabella Bird and Mary Kingsley (Birkett 1989, Blunt 1994). In this paper I will discuss the tropes and discourses employed by women such as Freya Stark, Rosita Forbes and Evelyn Cheesman in their accounts of their expeditionary work, and the popular and scholarly receptions of these accounts, in case studies drawn from the earlier part of my research period.

Isla FORSYTH | University of Nottingham, United Kingdom

Dwelling in the desert: Ralph Bagnold and desert exploration

'I'm here again to tell you something of the rather strange sequel to our rather useless hobby' (Bagnold, 1945, 30). These, the rather innocuous words of Ralph Bagnold in his address to the Royal Geographic Society (RGS) in 1945; the hobby was desert exploration, the rather strange sequel was setting up the covert reconnaissance and raiding Long Range Desert Group (LRDG). After Italy's declaration of war in 1940, General Wavell, Commander in Chief, Middle East, began a dangerous game of bluff in the desert. Wavell ensured that he drew on those servicemen who had a grounded understanding of the battlefield terrain; one such was Major Ralph Bagnold (Rankin 2008). Bagnold had previously been posted to Egypt by the British military during the interwar period, and the desert immediately captured his imagination. It was while in North Africa in 1926 that Bagnold carried out his initial field work on the desert and sand dunes (Goudie, 2004). This research instigated a long-term and detailed study, in part funded by the RGS, which he later published as *Physics of Wind Blown Sand and Desert Dunes* (1941). This text was the most comprehensive study of the

characteristics of the desert terrain, and it remains 'a masterpiece of scientific enquiry and analysis' (Welland, 2009, 149). It also drew military attention to Bagnold in WWII, whom it was felt was perfectly placed to be in charge of the covert desert unit; a force set up to cause logistical havoc behind enemy lines by employing geographic knowledge in order to read the desert for signs of enemy activity. By studying the LRDC, and in particular Bagnold's role, this paper will uncover how geographical knowledge became engrained into the prosecution of desert warfare, with lasting effects on the ethics and execution of battle. Furthermore, it will consider the multiple publics, including geographical societies, schools and the military, which were enrolled in developing Bagnold's study of the desert and who in turn informed the nature and character of his desert exploration.

Tatiana YUSUPOVA | Institute for the History of Science and Technology, Russian Academy of Sciences, St Petersburg, Russia

The history of the publication of a travelogue by Russian geographer Petr Kozlov in Germany: from national ambitions to international cooperation

In 1925, in Berlin, a book of an outstanding Russian explorer of Central Asia Petr Kozlov (1863 – 1935) entitled «Zur toten Stadt Chara-Choto» (Towards the Dead City of Khara-Khoto) was published, under the editorship of the eminent German geographer Wilhelm Filchner and with the assistance of two more renowned geographers, Sven Hedin and Leonid Breitfuss.

Petr Kozlov holds a special place in the history of the geographical exploration of Central Asia, recognized by the world's most prestigious scholarly associations, such as the Royal Geographical Society in London, the Italian Geographical Society, and the Institute of France.

P. Kozlov's numerous collections donated to Russian academic museums contributed largely to the advancement of many scientific disciplines, including zoology, botany, and geography. Apart from that, Kozlov is known for his outstanding archeological discoveries and excavations (at Khara-Khoto and Noyun-Uul); he also did much to popularize geographic knowledge and generate public interest in the lands he explored (Mongolia, China and Tibet), thus promoting the public perception of travelling as a form of professional occupation in the late 19th – early 20th century.

W. Filchner's publication project was another major evidence of the recognition of Kozlov's accomplishments by the international scientific community.

The paper will examine the history of the publication of Kozlov's famous travelogue in Germany by focusing on the personal motives of the people involved in the project, as well as on the importance of the undertaking for the promotion of the Russian-German scientific cooperation in the early 20th century.

S111-E. Geographical education and knowledge, part 1

Thu 25 July, 09:10–10:40 • Uni Place 1.219

Chair: Heike JONS | Loughborough University, United Kingdom

Keynote

Karen M. MORIN | Bucknell University, United States

Geographical literacies and their publics

This talk addresses the question of what is meant by geographical literacy in the U.S., and the implications for how the subject is defined, both within U.S. borders and outside of them. Tests that purport to measure geographical literacy raise questions about relationships

between university geography and what are assumed by many to be a geographically illiterate American public. I offer examples of the many close linkages that indeed exist and have existed historically – for better and worse – between university geography and many publics. Moreover, literate or other kinds of publics do not pre-exist discourse – they are brought into being and formed through it. Thus, associated with various geographical (il)literacies are various publics that exist or might be brought into being by various studies, actors, policies, or events. How we define geographical literacy carries significant consequences, particularly since arguments for tackling illiteracy are often associated with particular "pro-American" narratives and ambitions. Many who fret over geographical illiteracy appear mostly concerned that the U.S. retain a dominant global position, and argue that a return to education in regional or area studies geography will help ensure it.

Commentary: Manoel Fernandes SOUSA NETO | São Paulo University/CAPES, Portugal

Luise FISCHER | University of Edinburgh, United Kingdom

WITHDRAWN: Geographical education and eighteenth-century German 'learning' publics

Luz Maria TAMAYO | Universidad Nacional Autonoma de Mexico, Mexico

Dissemination of geographical knowledge in the nineteenth century by the Mexican Society of Geography and Statistics: published papers by one of its distinguished members

The need for geographical knowledge in Mexico led to the creation of the Mexican Society of Geography and Statistics. Since its foundation in 1833, its members have worked both to disseminate geographical knowledge and to inform government decisions at various levels.

The geographical engineer Francisco Jimenez was an active member of the Society and became its President in 1874. His prestige was high, because he worked in the Mexican Boundary Commission between 1848 and 1857, as well as in some other government ministries such as Foment. As a member of the Society, he conducted several studies that led to a wider and more precise understanding of the national territory. Some decisions made by the government were based on his work. The present paper analyses some documents by Francisco Jimenez, published in the Society bulletin, that led to the public spread of this knowledge.

S111-F. Geographical education and knowledge, part 2

Thu 25 July, 11:10–12:40 • Uni Place 1.219

Chair: Karen M. MORIN | Bucknell University, United States

Federico FERRETTI | University of Geneva - Department of Geography and Environment, Switzerland

Geography and its readers: imagination, popular education and political concern in the correspondence between Élisée Reclus and Pierre-Jules Hetzel (1867-1881)

After the works of Derek Gregory, we consider as geographical imaginations several ways of knowing or representing the world, which are produced not only by scientific geography, but also by the popular, vernacular or pedagogical expressions of what we call now geographical knowledge.

A recently-uncovered archive found contains the correspondences exchanged by Élisée Reclus (1830-1905), the famous anarchist geographer, and the publisher Pierre-Jules Hetzel (1814-1886), who made known authors like Victor Hugo and Jules Verne. These rather

hundred letters, now in course of publication, are an important primary source to uncover the material construction of the geographical knowledge in the public sphere during the 19th century, before the institutionalization of Geography as an academic discipline, and to analyze the related scientific and editorial networks.

Reclus and Hetzel worked together to publish two of the most known works of the geographer, *Histoire d'un Ruisseau* and *Histoire d'une Montagne*. Their exchanges dealt with several features of their common intent to present Geography to a wide public, for reasons which were not only economical, but also political. One of the first aims of Élisée Reclus was to promote popular, scientific and rational education not only for the children, but also for the adults belonging to the lowest classes, in order to improve the social propaganda of his "evolutionary anarchism". The main topics of this correspondence are the problems of a geographical pedagogy; the role of drafts and illustrations in the geographical edition; the geographical construction of the idea of landscape, and the authors' commentaries on several events of the history of France at the beginning of the Third Republic (during almost all the time of this epistolary exchange, Reclus was first imprisoned and then exiled in Switzerland after his participation in the 1871 Paris Commune).

Which are the common political stakes of the collaboration between a geographer who was at the same time one of the leading figures of the anarchist movement, and a publisher who was considered rather moderate, in spite of his republican ideas? Who were the readers targeted by their operation? Which strategies of communication contribute to build their discourse? Which kinds of geographical imagination emerge from the quoted works?

We'll try to answer analyzing this archive found, and the other Reclus' correspondences, helping us with the most recent bibliography on these topics.

Pascal CLERC | University Claude Bernard Lyon 1, France

Une «science» dans la ville: la géographie à Lyon, 1870-1939

Les recherches en histoire et épistémologie de la géographie portent en général, en France, sur la « géographie académique », appelée aussi « géographie scientifique » ou « géographie universitaire ». Cette approche qui borne étroitement le champ d'étude, contribue à construire une représentation de ce monde savant comme un objet autonome, déconnecté de la sphère publique et de ses contingences. Mais, si l'on adopte un autre point de vue en s'intéressant à un acteur ou un groupe d'acteurs, à un lieu (une ville, un État) où circule les savoirs, à une pratique, ou si l'on mobilise des outils comme ceux de l'histoire spatiale des sciences, on peut assez facilement mettre en évidence les relations étroites entre le monde académique et la sphère publique. La communication proposée est une analyse de l'espace intellectuel de la colonisation à Lyon entre les années 1870 et l'entre-deux-guerres. Durant cette période, les savoirs géographiques s'articulent de diverses manières avec les questions coloniales et au sein des milieux politique, économique et commercial. Prenons quelques exemples qui pourront être développés lors de la communication : la mobilisation de savoirs géographiques dans les missions « économique-coloniales » ainsi que dans la mise en espace des musées et des expositions ; le crédit accordé à la géographie pour développer un enseignement colonial et les liens entre l'Université et la Chambre de Commerce pour organiser cet enseignement ; la production de connaissances géographiques en « situation coloniale » et leur mobilisation dans la sphère académique ; l'engouement pour les savoirs géographiques coloniaux dans la sphère publique et les médias de l'époque. À différents niveaux et de différentes manières, les relations entre la géographie académique et l'environnement local sont étroites. Pour interpréter cela, nous examinerons notamment l'hypothèse selon laquelle le milieu universitaire lyonnais, alors très restreint, aurait été condamné à sortir de son pré-carré et, pour exister, aurait dû s'intégrer dans la sphère publique locale. De manière plus générale, la géographie académique ne peut plus être considérée comme un savoir pur, détaché de

contingences sociétales, économiques ou politiques. À Lyon comme ailleurs, les savants géographes nouent des relations avec les cercles du pouvoir, de la religion, de la finance, du commerce... ; ils dépendent de financements publics, font des choix politiques, participent à la vie de la cité. Ces contingences diverses construisent des liens complexes entre la sphère savante et la sphère publique.

S112. Geology in art and literature

Sponsoring body:

INHIGEO: International Commission on the History of the Geological Sciences (International Union of Geological Sciences and DHST)

Tue 23 July, 09:00–Wed 24 July, 10:30 • Uni Place 1.218

Symposium organisers:

Noah HERINGMAN | University of Missouri, United States

Ralph O'CONNOR | University of Aberdeen, United Kingdom

Symposium abstract

This symposium will explore the role of literary and artistic work in the production and communication of geological knowledge. 'Literature' and 'art' are broadly defined: papers will explore both 'high' genres (such as fine art, novels and poetry) and genres which are conventionally associated with science communication in which artistic form was no less important (such as maps and technical drawings). Papers will discuss figures and representational traditions from around the world from the late eighteenth century (when geology emerged as a science) to the twentieth century. Speakers will discuss the ways in which knowledge was shaped by the constraints and possibilities of artistic and literary forms or aesthetic demands, the role of art and literature in shaping wider public perceptions of geology, and the ways in which the work of geological knowledge-production has been represented in art and literature. To provide a genuinely interdisciplinary perspective on this nexus of practices, speakers will include historians of science, art historians and literary scholars.

This symposium will link with a proposed field trip to Coniston in the Lake District to visit the home of John Ruskin, whose career in the mid-Victorian period united the fields of literature, art and geology.

S112-A. The geological imagination

Tue 23 July, 09:00–10:30 • Uni Place 1.218

Chair: Ralph O'CONNOR | University of Aberdeen, United Kingdom

Muriel ADRIEN | Toulouse University, France

John Martin's scenes of deep time

Nowadays, Martin's popularity is at low ebb, and his paintings are viewed with more than a little condescendence, gently despised for their meretricious kaleidoscopic peplum-like qualities. Yet in his lifetime, they enjoyed tremendous success, and were also praised by the scientific community at large where Martin actively participated.

The surgeon-geologist Gideon Algernon Mantell held him in such esteem that he called on him to draw the frontispiece of his book, so did the fossil collector Thomas Hawkins and the curator Richardson later on. What drew Mantell and the two others to Martin, and why did they turn to him for their frontispiece? More generally, what accounts for this

contemporary success? What expectations of the early nineteenth-century audience did his paintings meet so well?

This paper will explore in what ways Martin's paleoimagery picked up various contemporary discourses and absorbed the issues, anxieties and fantasies of the day, and how they sent back to the viewers what they sought, offering them a digest of their fears and concerns under the guise of entertainment so as to defuse their disturbing power.

Martin's very popular and consensual work resonated with many different audiences. Conflicting theories—the diluvian, catastrophist, uniformitarian and plutonist theories, all at once—could be read in his paintings, such as in the *Deluge*; traces of scientific reflection in no way subverted religious convictions, nor did the violence depicted in his representations really threaten the established order.

In the same way as paleontology induced and crystallized fears, so did Martin's images: fears of seeing a social order overturned, fears of the exotic and primitive, but also more deep-seated fears of end-of-world scenarios, fears related to the precariousness, insignificance and even extinction of man. Although Martin zeroed in on contemporary preoccupations, he managed to disarm people's anguish and alarm by entertaining them with sensational images that were hardly seditious or destabilizing. Furthermore, Martin's imagery strengthened the order of things as viewed then, by presenting prehistoric times both as the natural locus of the origin of the nation—peopled with pseudo-dragons—, and as a foil to contemporary times.

Pascale MANNING | Western University, Canada

The mental traveller: Charles Lyell's geological imagination and the poetics of Romanticism

Near the end of the first volume of *Principles of Geology*, Charles Lyell establishes his theory of the geological imagination as a faculty capable of presenting the earth's deep past as an object of study. Time is no obstacle to the geological imagination. Lyell writes that as the traveller may traverse the earth's poles, so the imagination may unify, through the connective propensities of the mind, the apparently discontinuous occurrences of the past, "restoring" them to the individual's memory bank and making them available to mental visitation. This motif of the geologist as a special agent of memory occurs in Lyell's writing as early as 1827, in his review of Scrope's *Memoir on the Geology of Central France for The Quarterly Review*. There he writes that the scenes of the past may be "restored in imagination" through the extension of the scientist's thoughts into the past, resulting in the inclusion "within the compass of our rational existence, all the ages, even though they be myriads of years." My paper will first tease out the implications of Lyell's concept of the restorative imagination, and will then seek to situate his idea of this special recuperative faculty in relation to specific key texts of the English Romantic canon. We know from Lyell's letters to his father that he was an avid reader of Coleridge (and, by inference, most likely of Wordsworth). My paper will thus compare Lyell's theory of the imaginative faculty to Coleridge's, in the *Biographia Literaria*. Could Lyell's restorative imagination be a development of Coleridge's vital secondary imagination? I will read Lyell's notion of the imaginative faculty capable of beholding the past against aspects of Wordsworth's career-long effort to consider the retrievability of the past to the imagination. How does Lyell's restorative imagination echo Wordsworth's concepts of "spots of time," or "recollection in tranquillity," which so inflect his poetics? The object of my paper will be to briefly sketch the ties between Lyell's geological imagination and two of Romanticism's most prominent poetic thinkers on the thought-giving power of nature, and to thereby highlight heretofore unrecognized continuities between scientific and artistic literatures in the 19th century.

Laurence ROUSSILLON-CONSTANTY | Université Paul Sabatier Toulouse 3, France

A world in stones: John Ruskin and geology

In Victorian England, the new science of geology that was made accessible to a wide audience through the *Principles of Geology* written by Charles Lyell drove many authors and artists to look at the world in a new way. Among them, John Ruskin was one of the few to sustain and develop his interest in the subject throughout his life: at the age of twelve, he started writing a mineralogical dictionary and later remained an active member of Meteorological and Geological Societies. His very first published article, which appeared in London's *Magazine of Natural History* in 1834, also revealed his taste for science and geography in relation to aesthetics by offering an inquiry on "the causes of colour of the Water of the Rhine".

No doubt *Modern Painters* is the follow-up to the idea that science and art go hand in hand, and are tools to explore the natural world. In the same fashion, the enthusiasm for Turner and pre-Raphaelite painting can also be seen as a direct consequence of his scientific study of nature. Finally the collection of 40,000 rocks, fossils and minerals in the geology collection of the Sheffield Museum that Ruskin assembled as a resource for the education of the people testifies to his view that knowledge of science and art starts from close observation of our immediate surroundings and a personal mapping out of the universe.

In this paper, I should like to explore how Ruskin tries to use the new advances of science and geology to support his own vision of the world, sometimes using a geological approach to address his audience and impose his own narrative of landscape. I will then analyse the way in which Ruskin's geological research had an impact, not so much in the field of science as in his teaching of art and education where his knowledge of minerals was used as a metaphor.

S112-B. Geology between Enlightenment and Romanticism

Tue 23 July, 11:00–12:30 • Uni Place 1.218

Chair: Noah HERINGMAN | University of Missouri, United States

Ernst HAMM | York University, Canada

Caspar David Friedrich, geognosy and Romanticism

A number of the paintings of Caspar David Friedrich have become icons of German Romanticism and, beyond that, exemplars of a Romantic sensibility that could span linguistic and national boundaries and did find expression in the arts, literature and the sciences. Following the lead of the art historian Timothy Mitchell, who years ago showed the important ways in which the geognosy of Abraham Gottlob Werner resonated in a number of Friedrich's paintings, notably *Die Hochgebirge* and *Der Watzmann* (Timothy Mitchell, "Caspar David Friedrich's *Der Watzmann*: German Romantic Landscape Painting and Historical Geology," *The Art Bulletin*, 66 no. 3, 1984, 452-464), my paper will explore the interactions of geognosy and art in Friedrich's *The Wanderer above the Sea of Fog* (*Der Wanderer über dem Nebelmeer*). The image of a solitary figure standing on a rocky peak, facing away from the viewer and looking out over a fog-bound landscape interspersed with rocky summits, for which the outlines of higher summits serve as a backdrop, is among the most recognizable of Friedrich's work. Besides considering a number of geognostic motifs in *The Wanderer above the Sea of Fog*, my paper will also explore the ways in which this painting reflects the

growing importance that geognosy was having in the German-speaking nations (and the emerging senses of German nationhood), and the growth of “popular science” in a context where science was rapidly becoming “professionalized.”

Claudia SCHWEIZER | Independent scholar, Austria

The role of geology in the romantic concept of the junction of science and art: Novalis' (1772–1801), notes for a romantic encyclopaedia

Novalis (born as Georg Philipp Friedrich Freiherr von Hardenberg in 1772) was the son of the saline director in Saxony. Thus he grew up and acquired basic impressions of mining and science but also of pietistic ideas of the Moravian community, which his father had joined in. It was the mining family tradition that motivated Novalis in 1797, after having successfully ended his studies of the Law, to attend the Mining Academy of Freiberg, where he got involved with all geosciences, mathematics, chemistry, biology, mining science and even philosophy. Here he eventually became befriended with his teacher Gottlob Abraham Werner (1749–1817).

Under the influence of Johann Gottlieb Fichte's scientific doctrine (germ. Wissenschaftslehre) and evoked by his experiences at Freiberg, Novalis attempted forming his own world view, based on the idea of a profound interplay between science, Arts and philosophy. To this approach he joined the idea of the existence of progressive universal poesy claiming the inseparable link between poesy and science, attributing to poesy the ability of working into future. It has to be said that at the beginning of German Romanticism no single scientific disciplines were independently focused on. The investigation of nature as such led to the so-called 'natural doctrine' (germ. Naturlehre) following a priori the romantic idea of nature considered an inseparable entity.

By his philosophical approach, Novalis aimed at the edition of an all-encompassing Encyclopaedia of Arts and Sciences. This work has never appeared, though, as Novalis died early at the age of 29 years. However, informative material having been collected as preliminary work to the Encyclopaedia remained as Notes for a Romantic Encyclopaedia (germ. Das allgemeine Brouillon) with considerations on each term to be explained in the volumes. These notes had been created from 1798–1799 during Novalis' stay at Freiberg, and had repeatedly been revised by Novalis himself. It represents fundamental witnesses of early romantic concepts and valuable material in following the development and effect of ideas involved in the intention taken in hand. The Notes had been edited for the first time in correct chronological order by Hans-Joachim Mühl in 1983.

The presented data attempt to put forward the role of geology-related terms presented in the Notes and to explain the contribution of geological knowledge to the ensemble of Novalis' widespread notion of science and Arts.

Gabrielle SIMS | New York University, United States

Unhomely nature: Giacomo Leopardi's *La Ginestra* (1836) as critique of the benevolent, progressivist theories of nature in the Enlightenment and Romanticism.

This paper will focus on the geological aesthetics of Giacomo Leopardi's last long poem of 1836-7 entitled *La Ginestra*, o il fiore del deserto {Broom, the flower of the desert}. Specifically, I will show that the poem's appropriation of a properly geological gaze, of the newly-institutionalised geological directive of proximity to one's objects of study, acts as a critical strategy that effectively deconstructs the fallacies at the heart of early nineteenth century English, French, and Italian political progressivism and spiritualism. *La Ginestra*'s main line of cultural resistance comes through in its anti-picturesque figuration of volcanic catastrophe, as against the rather easy aestheticisation of catastrophe (as though it were not an actual existential threat) common to much

contemporary painting, scientific research, and travel literature in the century leading up to the poem's composition. The poem responds antagonistically to this trend in natural philosophy through an appropriate adoption of an emphasis on the visual and, as is evident in its recounting of the tragedy of Pompeii, makes a more-or-less explicit reference to the role of painting in promoting a misreading of nature as both spectacle and record-keeper. In the course of my paper, I will refer to the implicit positivism of contemporary geological art: including select gouaches by Pietro Fabris from William Hamilton's Campi Phlegraei and Constant Prévost's sketches of the so-called 'disappearing island' Giulia-Ferdinandea from 1831, during its most famous six-week appearance. My paper's consideration of the literature and painting of travel in Italy in relation to Giacomo Leopardi's poetry represents an entirely new line of research into the work of this Italian poet-philosopher. The argument is derived from the final chapter of my recently completed dissertation on Leopardi's adoption of a unique and strictly inorganicist form of uniformitarian geological philosophy throughout his poetry and prose.

Melissa BAILES | Tulane University, United States

Laughter and lava: Felicia Hemans, feminine propriety, and Romantic geology

While poems by early Romantic-era women such as Charlotte Smith often demonstrate taxonomic acumen in natural history, Felicia Hemans's works exemplify an aesthetic shift toward an alternate compatibility of science and feminine propriety. I chart this transition in women's scientific writings directly within Hemans's verse by analyzing two of her geological poems: "Epitaph on Mr. W—, a Celebrated Mineralogist" (ca. 1814-1816) and "The Image in Lava" (1827). Exhibiting clear knowledge of geology in the "Epitaph" on her mineralogist friend, C. Pleydell N. Wilton, who was still very much alive at the time of the poem's composition, Hemans's verses participate in a genre of geological satire that became popular among naturalists themselves. Yet, Hemans did not publish this epitaph in her lifetime; its first appearance in print occurred posthumously in 1836. One Victorian editor wrote of the work, "As may easily be supposed, [these verses] were never intended for publication" due to their lack of "feminine delicacy." Hemans's verses on "fossils, flints, and spars," granite, chalcedony, quartz, schist, gneiss, strata, and various other concepts and materials associated with geology, display a tone and specificity that her posthumous editor viewed as unbecoming of a serious female poet. Her "Image in Lava," on the other hand, written over a decade after the epitaph, embodies the high poetry of Romantic imagination. Despite the poem's dependence on readers' familiarity with the pumice rock resulting from lava flows, Hemans's depiction of a catastrophic destruction that preserves in ashes the tender relation between mother and child dominates the poem, subverting scientific concerns with those of domesticity. Differing markedly in content and public reception, her two geological poems dramatize the change in women's versification of natural history in the early decades of the nineteenth century. I argue that this altered sense of feminine propriety connects not only with the movement toward Victorian ideals, but also with the evolution in Romantic aesthetics that ensured the earlier depopularization of scientific verses like those of Erasmus Darwin and the increased valuing of emotive capacity in the poems of, for instance, Wordsworth and Keats.

S112-C. Geology and nineteenth-century fiction

Tue 23 July, 14:00–15:30 • Uni Place 1.218

Chair: Adelene BUCKLAND | King's College London, United Kingdom

Gowan DAWSON | University of Leicester, United Kingdom

Dickens, dinosaurs and design

Charles Dickens famously invoked the “Megalosaurus ...waddling like an elephantine lizard up Holborn Hill” in the opening scenes of *Bleak House*, but otherwise his novels only rarely feature images of prehistoric creatures. Since the mid-1840s Dickens had enjoyed a close friendship with Richard Owen, the foremost paleontologist in Victorian Britain, and, despite the paucity of actual prehistoric megafauna in his novels, Dickens was alert to the relevance of his friends’ paleontological methods for his fiction. In particular, Owen was famous for his ability to reconstruct extinct creatures by revealing the perfect relation between all the apparently anomalous elements of their anatomy, and showing that this harmonious relation between each part allowed habits of life that, while often ungainly, were closely suited to the particular environment in which the gigantic creatures had lived. Dinosaurs, a term Owen coined in 1842, were therefore monstrous and ungainly creatures, but nonetheless examples of perfect design. For Victorian novelists like Dickens, eager to disclose the underlying design of their own ostensibly ill-proportioned serialized fiction, this must have seemed a particularly appealing skill.

Like Tennyson’s preference for “compact and vertebrate poems” over verse formed limply from “organizable lymph”, Dickens envisaged the serial parts of his novels as fragments that required “*fusing together* as an uninterrupted whole” like the similarly fused fossil vertebra discovered in dinosaur remains. Owen insisted that the bones of such creatures could be accurately pieced together because of the “existence of design in the construction of any part of an organized body”, while, for Dickens, in writing serial fiction there “must be a special design, to overcome that especially trying mode of publication”. While Dickens’s earlier, more picaresque fiction was frequently condemned precisely for its “absence of design”, the notion of design was one that became increasingly crucial to the painstaking planning of his later novels. This paper will consider Dickens’s last completed novel, *Our Mutual Friend* (1863), and especially how Mr. Venus, the melancholic taxidermist who articulates skeletal structures according to a larger “pattern” exemplified—in language inflected with natural theological overtones—by the “bones of a leg and foot, beautifully pure, and put together with exquisite neatness”, helps reveals the novel’s own complex structural design.

Stephen ROWLAND | University of Nevada, Las Vegas, United States

The role of the writings of Mark Twain in shaping public perceptions of geology in the late nineteenth and early twentieth centuries

Among Anglophone literary writers of the late nineteenth and early twentieth centuries, Mark Twain (1835-1910)—the “father of American literature”—was probably the most influential in shaping public perception of the historical sciences, for four reasons: (1) he was arguably the most popular and influential Anglophone writer of his day, (2) he was writing during the formative stages of the historical sciences, (3) he had strong opinions about the reliability (or lack of reliability) of the historical sciences, and (4) he often wove his opinions into his novels and essays.

Twain was attentive to new developments in the sciences, particularly to the emerging views of deep time from geology, deep space from astronomy, and of the antiquity of man from archaeology. This interest is expressed in several of Twain’s writings. In *The Adventures of Tom Sawyer* (1876), for example, he explored the concept of deep geologic time and the insignificance of humans in the universe; in *Life on the Mississippi* (1883) he used his personal knowledge of abandoned meanders in the Mississippi River to examine and ridicule the concept of uniformitarianism—the philosophical underpinning of the emerging field of geology; and in his 1903 essay “Was the world made for man?” he discussed the debate about the age of the Earth, mentioning Lord Kelvin and Charles Lyell by name.

In the 1860s, ‘70s, and early ‘80s, when the age of the Earth, the antiquity of humans, and the concept of evolution were new and contentious issues, even among scientists, Twain’s typical pattern was

to burlesque or ridicule these ideas. In this mode he was reflecting and projecting skepticism within the American public of the fantastic conclusions of historical scientists that contradicted biblical accounts. However, in his last writings, in the first decade of the twentieth century, Twain’s treatment of scientific themes was much more sympathetic than in his earlier writings. In these later works he used the emerging respectability of scientific ideas to defend the historic sciences and to ridicule religious orthodoxy and biblical literalism.

Claudine COHEN | EPHE/EHESS Paris, France

A few remarks on geology and palaeontology in nineteenth-century French literature

The first decades of 19th century in France saw the triumph of the natural sciences. This period, dominated by such charismatic figures as George Cuvier, Jean-Baptiste Lamarck and Etienne Geoffroy Saint Hilaire, saw in particular the birth of two scientific disciplines, geology and paleontology. Both disciplines were going to bring about “a great and sudden revolution” that opened the vertiginous dimension of “deep time”, affecting profoundly the world vision and the imagination of their contemporaries. Imagination was not absent from science itself, from the operation of reconstructing extinct beings and fauna, to the construction of discourse with the necessary use of rhetoric figures, verbal creation, narrative and fiction for the creation and presentation of knowledge. But science also had a deep influence on artistic and literary imagination and creation. In this paper, I will attempt to analyse some aspects of the impact of the knowledge and practices brought about by these scientific disciplines upon French literature during the 19th century..

Throughout the 19th century, poets tried to represent and reflect in their works geological and paleontological knowledge. Poems such as Deille’s *Three Kingdoms of Nature* (1808) presented on a didactic mode the major themes of the natural sciences, and Louis Bouilhet published in 1854 a poem entitled *Les Fossiles* (written between 1852 and 1854), in which he told, in a form in turn lyrical and epic, the story of the successive appearance of vegetation, fauna and man, inspired by the themes of the geology and paleontology of his time.

However, As I will argue, the strongest literary impact of these disciplines should rather be sought in novels, the grand literary genre in 19th century French literature : in their plots are exemplified the adventure of scientific research, the oniric themes of the voyage through deep time, the fascinating discoveries and wonders of mineralogy, geology and paleontology, the passionate debates between scientists, and stressed the success and failures of these scientific disciplines. Examples will be drawn from George Sand’s *Voyage dans le cristal* (1854), Jules Verne’s *Voyage au Centre de la Terre* (1863), and the 3rd chapter of Flaubert’s last novel published posthumously in 1880, *Bouvard et Pécuchet*.

Philippe TAQUET | Muséum National d’Histoire Naturelle, France

The inspiration of the novelist Honoré de Balzac on Georges Cuvier’s life and works

The french naturalist Georges Cuvier (1769-1832) became so famous with his works in comparative anatomy, vertebrate paleontology and geology that he inspired during his life and after, numerous artists, sculptors, painters, caricaturists and novelists. Honoré de Balzac, the great novelist, used the methods of comparative anatomy for studying and reconstructing the extinct species introduced by Cuvier to build the 137 fictions of his “Comédie Humaine” as a comparative anatomy of the different people of the French society of the first half of the nineteenth century. The name of Cuvier appear in many pages of Balzac’s novels as a great poet able to explore lost worlds.

S112-D. The art of geological mapping

Tue 23 July, 16:00–17:30 ▪ Uni Place 1.218

Chair: Martin RUDWICK | University of Cambridge, United Kingdom

Karen COOK | University of Kansas, United States

The artistic rebirth and afterlife of George Bellas Greenough's *A geological map of England and Wales, 1819/20 (1st ed.), 1839/40 (2nd ed.), and 1865 (3rd ed.)*

A geological map of England and Wales by George Bellas Greenough (1778-1855) appeared in three editions. The first edition's *Memoir* (1820) discusses geological content but hardly mentions symbolization. Map design assumes a major role in the second *Memoir* (1840), where several pages advocate using area colors and patterns "to make the tints of a geological map speak to the mind as well as to the eye" (p.viii). The map's posthumous third edition (1865), revised by a Geological Society of London committee, appeared without a text.

Between the first and second editions Greenough converted into a crusading map designer. My exploration of his papers in English libraries and archives has uncovered several probable causes: criticisms of the readability of his map, proposals for uniform geological symbols, and the need to depict newly named geological systems. Greenough's papers record 75 information sources consulted while seeking ideas for map design. He met, corresponded with, and read the publications of artists, color scientists, color manufacturers (especially makers of watercolors), and other geologists and natural scientists.

While Greenough's idea of matching map colors with mineralogy is geological in basis, his other suggestions stem from the theory and practice of art and color science. These include juxtaposing harmonious and contrasting colors, reserving strong colors for small areas, and coloring groups of formations brightest in the center and duller outward. He also proposes limiting the number of colors per map but varying their tone by adding black line and dot patterns to differentiate related formations.

Shifting from Greenough's design intentions to their implementation, my use of a portable reflecting spectrophotometer and software for analyzing color on digital photographs has enabled me to measure and compare colors on copies of his maps in different library collections. Comparison of the first and second editions of his map reveals design improvements to the second edition, although hampered by his allegiance to associative color and technical problems with the black area patterns. Finally, a look at the third edition (1865) revised by a Geological Society of London committee, reveals that Greenough's design ideas not only live on but are more successfully expressed in this map.

Stefano MAGNANI | University of Udine, Italy

Painting geology: the Torquato Taramelli views

This paper will concern the use of paintings and artistic illustration in the work of the Italian geologist Torquato Taramelli (1845-1922). Field geologist and alpinist, but also skilled draftsman, he had a crucial role in the realization of the geological map of Italy, presenting the *Geological Map of Friuli* at the *Second International Geological Congress* held in Bologna 1881. The map was watercolor painted by Taramelli itself, offering an example of the sensible use of painting documents he made in his scientific works. These included both drawings in the field-diaries and acquaforti and watercolor paintings used to illustrate his scientific writings, many of which still exposed in the Rectorate of the Pavia University. The most important is the *Panorama geologico del Friuli da Moruzzo*.

They denote a considerable artistic talent, with a large number of views and foreshortening of landscapes or towns, and sometimes with extremely suggestive ethnographic accents. Through these works it is possible to read that he chose to use realistic painting and drawing not

only as mean of dissemination, to facilitate the technical data understanding, but also as a scientific tool tout court by which to record, highlight and investigate the geological nature and morphology of the territory. Behind this choice it is possible to recognize the influence of culture and tradition of Italian painting, that from Renaissance used the landscape as the background theme of the oeuvre, and that with its strong presence left no doubt that the design of geological relief was superior to photography.

Union of science and art, overall the drawings and watercolors respond to the need of explaining the geological relief. They also contribute to the creation of sections of the territory and express a pictorial and descriptive personal attention to the environment and the landscape. In fact, the value of views and landscapes, as well as the pictorial reproduction of individuals, monuments and objects goes far beyond the scientific interests of Taramelli, to attest his salient attitude and taste in the pictorial representation of the world.

This presentation is based on work co-authored by Stefano Marabini.

David OLDROYD | University of New South Wales, Australia

The geological maps of the world by Ami Boué (1843) and Jules Marcou (1861): the Australasian portions

Both Boué and Marcou were 'polymathic' geologists with extraordinary knowledge of the geological literature. In 1843, Boué exhibited a hand-coloured geological map of the world at a scientific meeting in Graz. Subsequently it was formally published in several French and English versions. The map(s) coloured virtually all land areas of the globe. How did Boué do it? He relied on reports from as many parts of the world as possible, utilised the tectonic theory of Élie de Beaumont but also made far-fetched analogies. And some of his information was essentially based on guesswork. Nevertheless, his achievement was remarkable and it enables us to see what was known of world geology in the mid-nineteenth century. And one can observe the development of his work through the map's several editions. The paper primarily focuses on Australasia and identifies the sources that Boué used for that part of the world and the extrapolations that he made. The two versions of Marcou's maps reveal the development of geological knowledge over the two following decades. His reading was no less remarkable, but he left some areas of the world blank and did not try to 'guess', where no information was available. The 'rationale' for producing such maps is briefly discussed.

S112-E. Communicating geological knowledge

Wed 24 July, 09:00–10:30 ▪ Uni Place 1.218

Chair: Ernst HAMM | York University, Canada

William TWYXCROSS | Independent scholar, Australia

The many arts of the father of seismology

John Milne, the "father of the seismology", died on July 31st 1913. This paper will be delivered 100 years to the week after his death. It will focus on Milne's extraordinary ability to communicate scientific/geological knowledge using both his artistic and literary skills, and most particularly in the context of Japan, where he enlisted the apparatus of the Meiji state to the cause of a new scientific discipline in a way unparalleled before or since. Professor John Milne, FRS, FRGS, was appointed at 25 years of age to the foundation Chair of Geology and Mining at the Imperial College of Engineering, Tokyo. To take up his post, he travelled overland to Japan through Russia, Mongolia and China in what became an eight month epic journey. While at the Tokyo University, he invented the modern seismograph, established the world's first seismological society and journal, and pioneered instrument-based studies of seismicity. He later established the first global network of seismographs. Milne was the consummate field artist, recorder, and communicator. He

published hundreds of scientific papers, and painted, photographed and drew to illustrate his work. He also wrote travelogues and poetry, and was a competent mapmaker and technical draughtsman. His vast photographic archive includes many beautiful hand-tinted magic lantern slides, some graphically illustrating the horror of earthquakes. They also give an insight into his life in Tokyo with his wife, Tone Horikawa. Archives from Japan (Tokyo University and The Northern Studies Library), Carisbrooke Castle, the London Science Museum (Wroughton Archive), the British Library and the IOW Public Records Office will be used to illustrate this paper. The paper will analyse in detail how “Earthquake Milne” used his extraordinary ability to communicate geological knowledge, as well as scientific rigour, to enlist colleagues, institutions, and the Meiji state to the cause of establishing seismology, for the first time anywhere in the world, as a science in its own right.

Irena MALAKHOVA | State Geological Museum, Russian Academy of Sciences, Russia

Dmitry I Sokolov: a pioneer of geology and an expert in literature

Dr. Irena G. Malakhova Department for the History of Geology Vernadsky State Geological Museum Russian Academy of Sciences malakhova@sgm.ru Dmitry Ivanovich Sokolov (1788-1852) has graduated from the Mining Military School in Saint-Petersburg. He devoted his life to geological education and enlightenment. More than four decades Sokolov lectured in the Mining Military School and the University of Saint-Petersburg. He was the teacher for few generations of Russian geologists and the author of the first Russian text-books on mineralogy (1832) and geology (1839, 1842). Sokolov was well-known as the ‘founding father’ of the first Russian magazine on mining and geology – “Mining Journal” (1825). As the editor-in-chief he promoted publications of J. Berzelius (1826), H. Davy (1826, 1829); F. Mohs, G. Rose, L. Élie de Beaumont (1830), A Boué (1833), L. von Buch (1840) in Russian. The experience of Sokolov in geoscience, and his literary talent were claimed by the Imperial Russian Academy. This society founded by Catherine the Great in 1783 was aimed at research of Russian language and literature. Six volumes of the ‘Academic Dictionary of the Russian Language’ were published in 1789-1794. This work was continued, and Sokolov was charged with description of mining and geological terms for the 6-volume ‘Dictionary of the Church Slavonic and Russian Languages’ (1847). The modern Russian language has been creating at the time when ‘erudition, politics and philosophy have not yet spoken Russian’ (Pushkin, 1825). The terms interpreted by Sokolov enriched the language as a whole and its scientific lexicon at the early stage of geological studies in Russia. The efforts of Sokolov were appraised by election a member of the Imperial Russian Academy (1839). In 1841 it was merged into the Imperial Academy of Sciences in Saint-Petersburg, and since that time Sokolov has been a honorary member.

Leonid KOLBANTSEV | A P Karpinsky Russian Geological Research Institute (VSEGEI), Russia

Vladimir Obruchev: the first state geologist of the Eastern Siberia, and the first Russian geologist-writer

Vladimir Obruchev (1863-1956) was a geologist and geographer, explorer of Siberia and Central Asia; Academician of the Soviet Academy of Sciences (1929). He was one of the most known geologists in Russia of the first half of the 20th century.

Obruchev graduated from the St Petersburg Mining Institute and was appointed the first state geologist of Eastern Siberia (1886). He carried out geological and geographical investigations in many regions of Eastern Siberia and Central Asia, was the Professor in Tomsk (1901-12), Taurida (1918-21) and Moscow (1921-29) universities; Director of Geological Institute (1929-33) and Institute of Permafrost Studies (1939-56) of the Soviet Academy of Sciences. Also, he was the member of geological and geographical societies of Germany, France, Great Britain, and the USA.

Many of his works deal with the origins of loess in Central Asia and Siberia, ice formation and permafrost in Siberia, problems of Siberian tectonics, Siberian goldfields. He published more than 1,000 scientific and popular scientific works. But the first art story (“The sea is noisy”, 1884) was published earlier than the first scientific article (1886).

Obruchev always aspired to popularize scientific knowledge and to transform even scientific publications into works of art. It can be seen in names of scientific articles:

“Hollows of Central Asia and their scientific treasures, expecting studying”;

“Riddle of the Siberian Polar region”;

“A role and value of dust in the nature”;

“Aeolus City” and others.

He also authored many popular scientific works, such as Formation of Mountains and Ore Deposits (1932), Field Geology (1927), Fundamentals of Geology (1944), etc.

Obruchev considered fantastic books by J.Verne, A.Conan Doyle and K.Hlouch were very weak and improbable from the scientific point of view. And in his science fiction books he aspired authentically to show achievements of science, especially in geology. But today some of his ideas seem very naive. Nevertheless, the best of Obruchev’s novels: “Plutonia” (1915) and “Sannikov Land” (1924) are now popular in readers, continue to be republished and sometimes readers start to argue: whether there were described events or it is an invention.

S113. Geologists in the field

Sponsoring body:

INHIGEO: International Commission on the History of the Geological Sciences (International Union of Geological Sciences and DHST)

Fri 26 July, 09:10–Sat 27 July, 12:40 • Uni Place 1.219

Symposium organisers:

Martina KÖLBL-EBERT | Jura-Museum Eichstätt, Germany
Leucha VENEER | University of Manchester, United Kingdom

Symposium abstract

This symposium explores the history of geological and geophysical fieldwork, examining the work of individuals, research groups and commercial explorers in all areas of the world and across history, and showing how geological knowledge was made in the field and transferred and disseminated through word of mouth, in correspondence, in institutional settings and through scientific publications, from the early modern period to the present day.

The symposium deals with the changing methodologies of fieldwork and the difficulties of administering it, followed by a session on the crucial importance of place and site-specific limitations. The symposium then considers the problems when fieldwork is under ideological and financial constraint, before turning to specific case studies, including the roles played by eighteenth- and nineteenth-century travellers, as well as the difficulties faced by investigators in their own local contexts.

All of these contributions will illuminate changing local and global trends in geological and geophysical fieldwork since the early modern period, considering the effects of national patterns and characteristics and innovations in instrumentation and techniques. The roles of particular individuals and groups, including amateurs and professionals, women and travellers, artists and scientists, and the importance of contexts as

varied as private interests, government surveys and commercial exploration will all be revealed.

One of the highlights of the symposium will be the display of a west-east section of northern England dating from the 1830s. This section was prepared by the mining engineer Thomas Sopwith, and is almost 13m (42 feet) long. It was recently purchased by the current owner, Graham Carlisle, and is thought not to have been displayed since the nineteenth century. It will be discussed by Susan Turner in session S113-B.

This symposium will also share a number of ideas and themes with S112, Geology in Art and Literature, and with the field trips being organized on behalf of the International Commission on the History of the Geological Sciences.

S113-A. Methodology of fieldwork

Fri 26 July, 09:10–10:40 ▪ Uni Place 1.219

Chair: Leucha VENEER | University of Manchester, United Kingdom

Andrew C. SCOTT | Royal Holloway, University of London, United Kingdom

The first illustrated geological field study, 1610–1630

In 1603 Prince Federico Cesi formed the Accademia dei Lincei with a group of friends. Cesi, together with Francesco Stelluti embarked on a systematic field collection of fossil woods from his lands around Aquasparta in Umbria, Italy. An integral part of this research was not only to draw and describe the fossils but to also place them in their field context using a series of field drawings. The work on the origin of fossils was not completed by the time of Cesi's death in 1630. Their researches were widely known around Europe as is seen in contemporary correspondence. After the death of Cesi Stelluti was persuaded to publish a short volume on the preservation of the fossils in 1637 titled "Trattato del legno fossile minerale". Only one of the field sketches, however, was included in this work and this probably represents a composite image. A map of the fossil localities was, however, included. The corpus of the drawings became part of the Paper Museum of Cassiano dal Pozzo and these were bought by King George III in 1762 and brought to England. The collection is now part of the Royal Collection in Windsor Castle belonging to Queen Elizabeth II. Among the group of drawings is a series of field sketches of such quality that the outcrops have been identified and fossils collected to match the 17th Century drawings. The Lincei study involved field and laboratory investigations and is the first detailed attempt to try to understand the origin of fossils using such a range of observations. The approach to use a combination of field drawings together with remarkably accurate drawings of the fossils from the rocks was not followed by others. It is possible that the interpretation by Stelluti, that the fossils were not once living, may have contributed to the neglect of this work. It is also possible that the quality of the published field sketch was less impressive than those in the original drawings and this also played a part in them being ignored. These researches were forgotten by the time more detailed and widespread geological observations were being made and the combination of detailed field and specimen drawings and descriptions did not become commonplace until more than 150 years later.

Kenneth TAYLOR | University of Oklahoma, United States

Fieldwork *avant la lettre*: Desmarest's field investigations in the 1760s

A distinctive common vocabulary corresponding to the modern conception of *fieldwork* was lacking among early francophone advocates of an empirically-founded earth science. Nonetheless, in the case of Nicolas Desmarest (1725-1815) records from as early as 1761-62 survive testifying to his investigations of specific local phenomena, reflecting an aim of building a Theory of the Earth out of evidence.

Desmarest's local observations characteristically focused on regularities in physiographic configurations. His descriptions of dispositional regularities frequently associated them with the ongoing operation of dynamic agents, especially running water. Documents from Desmarest's early field experiences indicate his capacity for broad spatio-temporal imagination in envisioning landscape transformation.

Ezio VACCARI | Università dell'Insubria, Italy

The role of fieldwork in Ami Boué's *Guide du géologue voyageur* (1835-36)

During the 19th century, the process of establishment of geology as a scientific discipline was reinforced also by the general acceptance and codification of the role of systematic fieldwork within textbooks for students and 'geological guides' for amateurs. The beginning of this trend may be traced not only in the practices of the travelling 'oryctologists', mineralogists and mining experts of the second half of the 18th century, but also in the early examples of scientific instructions for geological travellers. In his book in 2 volumes *Guide du géologue voyageur* (Paris, 1835-1836), Ami Boué (1794–1881), one of the founders of the Société géologique de France in 1830 and himself a great traveller, was in fact inspired by De Saussure's *Agenda* (1796) and Leonhard's *Agenda Geognostica* (1829), to write a long detailed chapter *Préparatifs et instructions préliminaires pour les voyages géologiques* (Boué 1835–1836, vol. 1, p. 9–158). He believed that his 'geological guide' could be easily used also by general readers and 'amateurs de la géologie', although a part of the first volume and the full content of the second volume could be regarded as a real textbook. The *Guide du géologue voyageur* can be considered a complete work for travelling geologists, with a specific text of very elaborate and detailed instructions. This was because Boué was also trying to organize and in some way propose a first codification of the activities and the correct procedures to be adopted by the geologists in the field. The aim of this paper is to analyze in detail the concept and the methodology of geological fieldwork expressed by Boué in his work, as well as to make a comparison with the contemporary geological literature and the early outlines of field-geology.

Marianne KLEMUN | University of Vienna, Austria

Administering science: the paper form of scientific practice, and of geological fieldwork

Every piece of fieldwork involves, in principle, countless administrative acts and procedures. These are preceded by the instruction which, in functional terms, can be attributed to two different levels. One consists of providing a methodology for the acquisition of knowledge; the other consists of the bureaucracy, or the organizational framework, within which the fieldwork takes place. Whilst on the one hand the investigator is striving for an optimization of the acquisition of knowledge, on the other hand the process of checking, both the active subject and the object of the investigation, is a concomitant feature of both aspects. The formulation of regulations and obligations, both during travel and in the field, corresponds to the requirement for unconditional documentation, however it is constituted. If one understands writing up and recording as knowledge-creating procedures that participate directly in the creation of scientific objects, then these records mark the threshold between the intellectual, the observed and the material conceptualization on paper. What is of particular interest is how, within this creative process of authorship, in addition to the subjective gestures of writing and provisional drafting, general routines are simultaneously adjusted that may be understood as strategies of objectiveness (in the sense of Daston's "mechanical objectivity"), which are more or less independent of the subject. For routines of this sort were cultivated, and corresponded to disciplinary standardization. Whatever the case, the organization of the material in different systems of notation, in lists, according to different formal viewpoints in protocols, reports, diaries and journals (the "Little Tools of Knowledge") does not happen by chance,

since every format that may be selected is also part of an agreement that is shared in the praxis by the community.

Using a variety of selected handwritten materials that were produced during fieldwork in the context of the geological mapping project (1848–1867) of the Habsburg Monarchy, commissioned by the Royal Imperial Geological Survey in Vienna, I should like to address this way between subjective observation and written documentation, the conceptualization of experience and the strategies of writing, and also the procedures for standardization. Through this, fieldwork becomes a procedure that is materialized on paper.

S113-B. The importance of place

Fri 26 July, 11:10–12:40 • Uni Place 1.219

Chair: [Martina KÖLBL-EBERT](#) | Jura-Museum Eichstätt, Germany

[Susan TURNER](#) | Queensland Museum, Australia

Thomas Sopwith's 1839 'Great Strata Section': Cross Fell Mountain to Hownes Gill

A horizontal cross-section at a scale of 300 feet to the inch and vertical section 100 feet to the inch dated December 1839 made by Thomas Sopwith (1803–1879) of Newcastle spans the Carboniferous Limestone from Cross Gill, Cumberland to Hownes Gill, Co. Durham, and measures 42 feet long (~13 m) by 2 feet 5 inches deep (nearly 1 m). The section is now owned by Graham Carlisle, who will be present during the paper to display it and answer questions about its provenance.

Sopwith must have walked the '28 miles 12 chains 60 links' as he knew the whole district when young walking hills and dales learning his geology by observation. Sopwith decided in 1824 to train as a lead-mine surveyor at his own expense and became apprenticed to J. & T. Dickinson (or Dickenson) of the north of England lead mines. There he undoubtedly devoured Westgarth Forster's (1809, 1821) classic of the geology from Newcastle to Cross Fell to which his mentors were subscribers. As Rudwick pointed out in 1976, Forster was the first to provide stratigraphic columns; Sopwith produced his own first book with sections in 1829 based on his apprenticeship years and a further one in 1833. From his diary we know that Sopwith was fully aware of Werner's ideas (1809 translation) but it was the influence of Buckland and Smith that swayed his emphasis. On the section there are pencil notes regarding colours to be used; colour coding was one of Sopwith's fortés, this example predating work at the W.B. Lead Mines, where he was chief agent from 1845. The purpose of the section is not yet certain but he was working that year or the previous one on a model of part of Alston Moor and Nentsbury lead mines (his model XVI) and he exhibited on Alston Moor strata at the 1838 British Association for the Advancement of Science (BAAS), and on November 6th 1839 Sopwith lectured to Durham University students about plans, sections, geological drawings, and models, and even Adam Sedgwick viewed it. Since the 1820s Sopwith had honed his skills in isometric drawing in this area and made sections and later the large one-off model to show structure; by the late 1830s he had begun to think about making his smaller models. This is Sopwith's two-dimensional magnum opus, the result of his early fieldwork on his testing ground in the northern Pennines. Sopwith's field skills were recognised in late 20th century by K. C. Dunham and later geologists working in the same area, and, based on the associated maps, one of these men may have owned the Sopwith section in the mid-1970s.

[Luz AZUELA](#) | Universidad Nacional Autónoma de México, Mexico

Scientific and political meanings in William Gabb's journey in Baja California

The Californian Gold Rush stimulated expectations of discovering similar riches in Baja California, a territory conceived as possessing similar

geological constitution. During those years, a few mining enterprises were established, such as San Rafael (1850), La Candelaria (1851), Rancho San Isidro (1853) and San Jacinto (1853), but all of them resulted in small deposits. In the 1860's, however, bigger enterprises, such as Triunfo Gold and Silver Mining Company, Tesoro Silver Mining Company and Santa Cruz Silver Company, were founded. Their success promoted immigration from entrepreneurs and mining workers, causing fear of annexation plans from the U.S.A government.

President Juarez decided to regulate the progressive immigration by means of a colonization lease that promised land and tax exemption to an American company, required to undertake the scientific exploration and colonization of a long share of Baja California's territory. In exchange, the Lower California Company promised to include a third of Mexican citizens into the potential colonists.

Scientific exploration followed and geological inspection was entrusted to William More Gabb (1839-1878), an American geologist born in Philadelphia, who had already participated in different geological expeditions in the West Coast. Gabb was a disciple of Martin Hans Boyé (1812-1907) and James Hall (1811-1898), whose influence can be confirmed in Gabb's large scientific production, comprehending geological exploration of Peru (1867), U.S.A.'s West Coast (1867), Santo Domingo (1871, 1872), Curazao (1873) and Costa Rica (1874, 1875, 1898).

This paper proposes to analyze Gabb's expedition in Baja California, which was executed from December 1866 to April 1867, and resulted in several scientific papers and journalist reports. The former dealt with Baja California's botanical, zoological, paleontological, geological and ethnological resources, while the latter speculated on its possible annexation to the U. S. A.

Therefore, Gabb's expedition produced scientific knowledge impregnated with political meanings, that were influential in annexation debates in the years that followed.

This presentation is based on work co-authored by Óscar Moisés Torres Montúfar.

[Beth A. JOHNSON](#) | University of Wisconsin-Fox Valley, United States

Glacial Lake Agassiz and its early researchers: from Noah's flood to Upham's bathtub and beyond

After the Laurentide Ice Sheet (LIS) reached its maximum extent in North America 18,000 14C yr B.P., it underwent a period of rapid retreat, generating large volumes of meltwater that collected in proglacial lakes along its margin. The largest and most extensive of these was glacial Lake Agassiz, which existed from 11,700 14C yr B.P. to 7,500 14C yr B.P. In 1823, when William Keating first described what became known as Lake Agassiz, the prevailing idea explaining such past lakes was that they were remnants of Noah's Flood. Keating interpreted the site to be the lakebed of an ancient lake, one of the spillways of which was the Mississippi River and, although he was careful not to make any biblical references to the lake's formation, he also resisted the interpretation of glacial assistance in formation. Subsequent researchers, such as David D. Owen, George Dawson, and G.K. Warren, agreed with the interpretation of a large lake and although Louis Agassiz's glacial theory was becoming more accepted, they did not attribute the lake as proglacial. Instead, hypotheses ranged from transportation of glacial drift via floating ice to ponding behind terminal moraines. It wasn't until 1873 that N.H. Winchell, first state geologist of Minnesota, published his discussion on the work of previous researchers and proposed Lake Agassiz's proglacial origins.

Lake Agassiz was named in honor of Louis Agassiz in 1880 by Warren Upham, who spent the next couple of decades researching and publishing on the lake for several state and government agencies in the United States as well as Canada. Upham associated the existence of the

lake to a single retreating ice sheet, in line with George Dawson's work on the LIS. In 1895, he published his seminal work, the U.S. Geological Survey's Monograph 25 *The Glacial Lake Agassiz*. However, problems arose from Upham's interpretation of a single filling and draining of the lake. Joseph Burr Tyrrell published research in 1896 and 1898 that suggested Lake Agassiz formed as a result of action by multiple ice sheets, an interpretation that put Tyrrell at odds with Upham for more than twenty years. Further damage was done to Monograph 25 when William A. Johnston contradicted the "single fill" hypothesis and stated that there had been at least two fillings and drainages of Lake Agassiz. This resulted in Upham publishing his strong disagreement with Johnston's interpretations and making a public call for support from the geological community. This resulted in a compromise proposed to try to reconcile the interpretations of the two researchers. Unfortunately, this compromise was not based on the geological evidence and set Lake Agassiz research back.

Barry COOPER | University of South Australia, Australia

A 'sense of place' in geology: the case history of four locations from South Australia

Geologists have a pronounced "Sense of Place". It means that specific field localities hold special significance for research, teaching, public interest in geology as well as history. In this paper four geological localities from South Australia will be discussed that illustrates this concept.

Hallett Cove offers the best example in South Australia of this phenomenon as it provides a classic locality demonstrating Late Palaeozoic glaciation in Australia. The glacial pavement at Black Cliff was discovered by Ralph Tate in 1877 who later led "the largest scientific excursion in the southern hemisphere" to the site in 1893. The site has become an essential geology teaching locality whilst in the 1970s it was the site of a vigorous conservation battle until a wide area was preserved around it. Over more than a century it has also excited controversy as geologists have queried its glacial origin and have variously attributed a Carboniferous, Permian, Cretaceous and Pleistocene age to the glaciation.

The coast along Maslin Bay / Port Willunga offers the primary reference section for Late Eocene and Oligocene time in Australia. Ralph Tate also demonstrated its importance as early as 1877 through the description of numerous fossils coupled with recognition of its time significance. Since the 1940s, a legion of geologists, led by Martin Glaessner, have also studied the coastal cliffs. They have been followed by students and even accompanied by artists who are attracted by the beauty of the high, yet readily accessible cliffs.

Another long-recognised iconic geological region is the Flinders Ranges, centred initially on Wilpena Pound and more recently on the nearby Brachina Gorge transect. Since 2004, this region also holds the international GSSP site defining the base of the Ediacaran Period.

Also of importance are the Quaternary coastal environments of the Coorong in the SE of South Australia which have also interested geologists since the 19th century and most especially since the mid 20th century.

S113-C. Constraints on fieldwork

Fri 26 July, 14:10–15:40 ▪ Uni Place 1.219

Chair: C John HENRY | History of Geology Group, Geological Society, United Kingdom

Cynthia BUREK | University of Chester, United Kingdom

Bettie HIGGS | University College Cork, Ireland

The role of women in geological fieldwork: case studies from Ireland and the UK

The role women have played in fieldwork has been important but largely overlooked. Perhaps the most famous of these is Mary Anning. Often they were crucial to advances in field geoscience but this has rarely been acknowledged in the published literature or by their peers. It is important to remember that they worked in a societal culture that made field travel difficult. Not only that, but they could only be part of the scientific debate if they were fortunate enough to have a brother, father or husband already involved.

Building on the findings of a conference organised by the 2 authors, two case studies focusing on the UK and Ireland will highlight the important contribution made by women in field geoscience throughout the late eighteenth century and the nineteenth century. Their roles included artistic painters, illustrators, tutors, fossil-hunters, editors, Note takers, translators, museum workers, field assistants and field leaders. Important discoveries were made by women, and significant fossil and mineral collections were constructed, but it was not until the last decade that some of this work has come to light. Archives of local and national geological societies, letters and memoirs show that the esteem that some women fieldworkers were held in is occasionally acknowledged by their peers. The paper will briefly compare the situation in the UK and Ireland at that time with developments around the world. We ask what legacy has been left and if this affects the gender distribution in field geoscience today.

Martina KÖLBL-EBERT | Jura-Museum Eichstätt, Germany

No trespassing: field-geology at Ries Crater within the framework of "German Geology" (1933 to 1945)

During much of the twentieth century, up to the early 1960s, geologists in Germany regarded themselves as "Earth-historians" working mainly on local stratigraphical problems delineating the geological history of a given landscape by means of elementary fieldwork; i.e. geological mapping equipped with hammer and walking boots.

Thin sections, mineralogical and chemical analysis, however, were no regular part of a geologist's toolbox. Such instrument- and laboratory-based methods were regarded as the province of mineralogists, who dealt with ahistorical, geological processes.

This distinction in working styles became ideologized from 1936 onwards with an increasing influence of nationalistic propaganda in Nazi Germany, leading not only to a disconnection of geology in Germany from the international scientific community but even to the attempt to develop a distinct 'German Geology,' which by definition was declared to be superior to the 'Anglo-Saxon' or the 'Christian-Jewish' styles of geology supposedly being practised elsewhere.

Even though the attempt of bringing geology in line with Nazi ideology was the effort of few individuals, their arguments crept into the mainstream, stealthily influencing contemporaneous debates such as the 'Ries problem.'

Since 'German Geology' denounced uniformitarianism as an 'Anglo-Saxon corruption of geology' and hailed the geological history of landscapes in Germany as unique, it favoured non-actualistic models and shunned process-oriented comparisons with other, similar structures elsewhere on Earth.

The deficiency of this methodology became apparent, when the 'Ries problem' was solved in the early 1960s by US-American mineralogists, who successfully interpreted the structure as an impact crater and thus as wholly unconnected with the geological pre-history of the location.

Teresa Salomé MOTA | Inter-University Centre for the History of Sciences and Technology, Portugal

Spending some time in the field: fieldwork in the Portuguese Geological Survey during the twentieth century

The paper aims to reveal how geological fieldwork was conducted in the Portuguese Geological Survey during great part of the twentieth century. We will see that in the first decades field assistants played a key role in conducting fieldwork and special attention will be given to their training. During the 1940s, the Portuguese Geological Survey could only rely on the French geologist Georges Zbyzsewski to conduct fieldwork and he was responsible for the introduction of new practices. However, field assistants were still the heirs of the Survey early scientific tradition, so compromises had to be established between them and the new French geologist when conducting fieldwork. In the meanwhile, scientific collaborators from outside the institution also began to play a key role in conducting fieldwork. From the 1950s, several new elements were hired to become part of the Survey technical staff, especially geologists and field assistants. The growth of elements in the technical staff with different scientific background and past experiences regarding fieldwork led to the creation of teams with specific and particular characteristics. Developments in fieldwork in the Portuguese Geological Survey were closely linked to economic policies implemented by the Portuguese State during the period studied, therefore an analysis of this relationship will also be made.

Leucha VENEER | University of Manchester, United Kingdom

Geological investigation or commercial exploration? State surveys of the British North Sea during the Cold War

Changing practices in British governance of civil science in general, and of geology in particular, in the 1960s led to the formation of a new body, the Institute of Geological Sciences (IGS), which, as well as maintaining the other duties associated with what was previously the Geological Survey of Great Britain, was swiftly given responsibility for surveying and mapping the geology of the North Sea bed. This had become a matter of urgent necessity following the discovery of gas and oil under the North Sea in the late 1950s.

The British Government had begun issuing commercial licences for the exploration and exploitation of this gas and oil in the mid-1960s. By 1967, however, officials in the Ministry of Power (which controlled the licensing process) were becoming aware that they needed much greater expertise in the geology of the North Sea than they currently had. Furthermore, since the first licences would expire in 1970, this knowledge needed to be gathered very quickly. The Ministry was already under external pressure to increase its technical arm, but officials considered that it would be too difficult to generate sufficient expertise internally, and therefore turned to the newly created IGS.

As the pressures of this situation continued to increase and the production of scientific results as quickly as possible became more and more important, the Director of the IGS, Kingsley Dunham, began to feel that the survey work his staff were doing for commercial and government agencies was compromising their more basic survey functions, and that while the income from contractual work was welcome, the continual cuts to the Institute's state-funded budget would in the end make both the basic surveying and the contractual work more difficult.

This paper therefore considers, through a study of the early years of the IGS and its surveys of the North Sea, how matters of governance reshaped state geology in the Cold War, affecting the relationships between ministries and scientific experts and at the same time reconfiguring geological surveying, scientific funding and debates over 'pure' and 'applied' science.

S113-D. Fieldwork case studies

Fri 26 July, 16:10–17:40 ▪ Uni Place 1.219

Chair: Barry COOPER | University of South Australia, Australia

Ermelinda PATACA | Universidade de São Paulo, Brazil

Philosophical travels in the Portuguese world: perceptions and experiences in fieldwork, 1777-1808

In the late eighteenth century Portugal created an intense effort to research colonies through Philosophical Travels. In this paper we propose to analyze the performance of the travelers on the Portuguese World - the Kingdom and the colonies in America, Africa and Asia. We analyze the creation of the perception and experience of travelers in two distinct political moments by the administration of Ministers of the Navy and Overseas Dominions - Martinho de Melo e Castro (1777-1795) and D. Rodrigo de Souza Coutinho (1796-1808). We analyze the travels circumstantially, evaluating how the trips were conditioned by the dynamics of the Portuguese empire built over the colonization process. During the two ministries were created conditions of mobility or fixity of the travelers on the Portuguese World who determined the complexity involved in field work in each period. We analyze the continuities and discontinuities between the two moments, through the creation of four distinct groups of travels. At first we analyze the performance of the naturalists who returned to Lisbon at the end of his voyages to the colonies and assumed administrative positions in important Portuguese scientific institutions to direct new naturalists in travels. The second group is characterized by fixity of travelers who stayed at the same area after the exchange of ministry, which provided more detailed observations of the places. Mobility is characteristic of the third group of travelers who explored new regions of the Portuguese Empire. Finally, the last group will feature perceptions completely new, since they left Lisbon towards the colonies for the first time. We analyzed the extensive documentation of texts and images created during the process to perceive the distinctions between the groups. We constructed detailed everyday routine of travelers to evaluate the complexity involved in field practices and the creation of new benchmarks of observation and interpretation in the period. The perception and the performance of naturalists are distinguished by expertise in distinct geographical and geological environments along the Portuguese World. Aspects such as topography, climate, hydrography and vegetation determined the routes, practice field, results and records of each trip.

Geir HESTMARK | University of Oslo, Norway

A tale of two moraines: Jens Esmark's path to the Ice Age deciphered

In 1824 Danish-Norwegian geo-scientist Jens Esmark published a paper claiming that there was indisputable and sufficient evidence to prove that the Norwegian landscape had previously been covered by enormous glaciers that had carved out valleys and fjords, glaciers reaching down to sea level. The erratic boulders of Northern Europe and the Alps and Jura mountains he likewise explained, and presented an astronomical theory of changes in the eccentricity of Earth's orbit to explain the climate changes indicated by the field observations, a clear precursor of the Milankovitch theory. More and more Esmark has been recognized as the discoverer of ice ages, yet the genesis of his glacial paper has remained almost a complete mystery. Based on previously unpublished sources the present paper shows how the discovery represented the convergence of several paths in his research interests and activities previous to 1824. First, a deep interest in weather and climate; from January 1799 to December 1838 he made thermometer and barometer readings three times a day, and in practice became the first Norwegian state meteorologist. Secondly an interest in the determination of conspicuous 'lines in the landscape' such as tree-lines and snowlines, which he measured barometrically on first ascents of many of Norway's highest peaks. Esmark also cooperated with a number of naturalists who studied extant Norwegian glaciers up close, providing them with his barometers for altitude measurements of glacier fronts and snowlines. Fourth, Esmark pondered the genesis of fjords and valleys in Norway, seeking an erosional agent that could explain the removal of large rock masses. Fifth, during a three month long voyage in the summer of 1823 along the Norwegian west coast and a subsequent mountain traverse,

Esmark and two accompanying students made a series of crucial observations of moraines and polished cliffs that indicated former large scale glaciations down to the seashore. During the mountain crossing they studied glacier effects and moraine formation up close. The mountain path they followed and which extant glaciers they examined have until now been unknown and subject to much speculation. The present paper for the first time documents their mountain traverse – the path and the observations that early September 1823 led to the discovery of Scandinavian Ice Ages.

Mike JOHNSTON | Independent scholar, New Zealand

Thomas Ridge Hacket (1827-1884): New Zealand's first geologist

- Thomas Hacket was a London born mining geologist who trained and worked in Germany before arriving in Nelson, in 1857, as manager to the Dun Mountain Copper Mining Company, thereby making him the first professional geologist in New Zealand. His younger brothers Charles (1831-1901) and James Henry (1839-1914) also pursued geological careers, the latter in Australasia. In Nelson, Hacket advised on mining and engineering projects in the north of the South Island and acquired a good knowledge of the diverse rocks that make up New Zealand. He provided this information to the German geologist Ferdinand von Hochstetter who visited parts of the country, including Nelson, in 1859 and is recognised as the “Father of New Zealand Geology”.

In Otago, in the south of the South Island, Hacket at times assisted James Hector, the Otago Provincial Geologist who had been appointed in 1862, fresh from the Canadian Palliser Expedition. Hacket recognised that many Otago rocks were similar to those in Nelson and nearly 100 years later it was realised that these rocks had been offset 480 km by horizontal movement on the Alpine Fault. After Hector became the first director of the NZ Geological Survey in 1865, Hacket helped on various surveys, the most notable being of the coalfields of the South Island's west coast.

Unable to get permanent employment, Hacket went to Australia in 1868 and was appointed a mining surveyor, then geologist, at the newly discovered Gympie Goldfield in Queensland. Hacket arrived just as the field was changing from an alluvial to a reefing one. He recognised the structure of the reefs and produced a geological map of the goldfield in 1870, ironically a year after losing his job when the Queensland Survey was disbanded. He then had a chequered career as a goldfields administrator at various Queensland goldfields until 1877. Except for his Gympie map, Hacket authored no major publications while in Australia. However, his foremost scientific contribution was to keep Hector informed of geological developments in eastern Australia. In particular, he realised that rocks in Gympie were similar to those in Nelson, a correlation not accepted until 130 years later. Hacket's letters to Hector are in Te Papa, the Museum of New Zealand but the letters he received in return are lost. Hacket returned to New Zealand in 1878, dying in Nelson six years later.

Christer NORDLUND | Umeå University, Sweden

Peat bogs as archives: Lennart von Post and the development of pollen analysis during World War I

By exploring the early history of quantitative palynology, especially the cultural processes and material practices through which pollen became data and peat bogs turned into geological and biological archives, the aim of this paper is to demonstrate how applied field science may give rise to basic laboratory science due to the articulation and establishment of a new type of data. In 1916, at the 16th Convention of Scandinavian Naturalists in Kristiania (Oslo), a novel quantitative method for the analysis of postglacial vegetation history was presented. The idea behind the method, later known as pollen analysis, was to utilise fossil pollen from peat bog deposits as data. In the historiography of palynology, this lecture by the geologist Lennart von Post (1884–1951), who delivered the lecture, remains a classic. Pollen from postglacial

deposits had indeed been used before, but through the launch of the so-called pollen diagram, by which von Post was able to summarize and visualise a large amount of data, the method reached a breakthrough within quaternary geology and later also in archaeology. Quaternary geology, including historical plant geography, had its academic seats at the universities and state geological surveys. But when it comes to early quantitative pollen analysis, I will argue that it was strongly linked to a certain peat bog inventory, conducted in southern Sweden in the 1910s. The motive behind this state funded inventory was economical and political: to pave the way for a domestic peat industry and secure energy resources during World War I. In the end, the inventory did not affect the state of the nation at all, but it contributed to the development of pollen analysis, simply because it was data collected during this fieldwork that made up the empirical foundation for von Post's method. The method was not without problems, however. One problem was how the pollen curves were to be interrelated chronologically; another had to do with credibility: were peat bogs really trustworthy as “archives”? In order to facilitate further studies, the Geological Survey stored the pollen samples from the inventory in a certain Pollen archive. Hence, one may say that the data travelled, from a natural archive to a scientific one.

S113-E. Travels and new worlds

Sat 27 July, 09:10–10:40 • Uni Place 1.219

Chair: Kenneth TAYLOR | University of Oklahoma, United States

George VLAHAKIS | Hellenic Open University, Greece

Unearthing the earth: geology in eighteenth- and nineteenth-century Greece

After Sotirios Vlahakis research in primary sources and relevant bibliography, we are able to present an outline of the history of geology in eighteenth- and nineteenth-century Greece. Since the mid eighteenth century, though politically still under the Ottoman occupation, Greek scholars showed a particular interest for natural sciences as part of a wider intellectual movement known as modern Greek Enlightenment. Therefore, among others, they developed a program for the publication of compilations or translations of popular European textbooks on physics, chemistry, mathematics, botany, astronomy etc. For several reasons, which we are going to discuss in our presentation, they failed to publish a book exclusively devoted to Geology. Nevertheless a significant body of geological knowledge was incorporated in the above mentioned books and the most prestigious Greek scientific journal of that time *Hermes the Scholar*. Furthermore a number of unsystematic but still valuable references to the Geology of the Balkans is to be found not only in the printed books but also in the manuscripts of the so called long 18th century, which for Greece lasted until 1821, when the Greek War for Independence started. After the establishment of the new independent Greek state and the University of Athens (1838), Geology became one of the main lessons in the Department of Physics and Mathematics. The key persons for the development of Geology in Greece during the second half of the nineteenth century are Iraklis Mitsopoulos (1816-1892) and his nephew Konstantinos Mitsopoulos (1844-1911), after relevant studies in Germany. Both, developed Geology, not only theoretically but they did also a precious work in the field. Iraklis Mitsopoulos taught Physics, Botany, Zoology and Geology and initiated the famous Pikermi excavations. Several species discovered were eventually named after him, an example being *Ithyringotherium Mitsopuli*. Konstantinos Mitsopoulos is considered the pioneer of experimental geology in Greece and one of the first supporters of the Darwinian Theory. He was also the prime mover behind the publication of the journal “Prometheus”, one of the first scientific journals to appear in Greece. In addition they published a number of articles with more popular character in order to improve the interest of the public for the science of Geology. The second part of our presentation aims to discuss their contribution for the development of

Geology in Greece and to trace the long way until much later the first independent Department of Geology established in the University of Athens (1982).

Bernhard FRITSCHER | Ludwig Maximilian University of Munich, Germany

Cultures of travelling and geological fieldwork: Heinrich Girard's *Geological Wanderings*

During the last quarter of the 18th century, Abraham Gottlob Werner (1749-1817), lecturer for mining and mineralogy at the Freiberg Mining Academy, was widely acknowledged as the most influential mineralogist/earth scientist of his time. In quite a similar way, the English country squire Charles Lyell (1797-1875) became the leader of the discipline in the 19th century, mainly due to his *Principles of geology* (1830-1833), the most influential geological text book of the century. Both men's concepts of the study of the earth show several differences. One of the most remarkable ones related to travelling, and geological fieldwork. While Werner's ideas on the formation of the earth were based mainly on the descriptive natural history of minerals and rocks, Lyell emphasized travelling and field work as indispensable requirements of geological work.

The present paper discusses this fundamental and immediate change of geological methodology within a few decades in early 19th century with particular regard to its cultural settings, i.e. to the idea of "national styles" of science. In a first part some remarks are given what, in this respect, might be called the "invention" of geological field work by the British country squires of the London Geological Society. In a second part it is asked for a contrasting, more "contemplative" ("German") practice of geological travelling and geological fieldwork, focusing on Heinrich Girard's (1814-1878) "geological wanderings" in Switzerland and France. Girard has been a professor of mineralogy and geognosy at Halle (Germany) since 1853. From the beginning travelling and field work were essential parts of his work. He had started his career at the university of Berlin where the chemist Eilhard Mitscherlich (1794-1863), the geographer Carl Ritter (1779-1859) and the mineralogist Gustav Rose (1798-1873) have been among his teachers. Particular important, however, became several travels accompanying the Berlin botanist Heinrich Friedrich Link (1767-1851) to Italy, and, for several times, also the geologist Leopold von Buch (1774-1853) who became his mentor, at all. In 1845 he became a Privatdozent for mineralogy at Berlin publishing his first more comprehensive geological papers, which were mainly the result of a series of wanderings in Northern Germany, mostly together with his students.

Wolf MAYER | Australian National University, Australia

Perceptions of the landscape and geology of Australia as revealed in the accounts and images of explorers, travel writers, artists and early settlers

The first written accounts of Dutch, English and French explorers of Australia's western and southern coasts, in the seventeens and eighteens centuries, left readers in Europe with the firm impression of the southern continent as an inhospitable, dry and largely featureless land, barely fit for human habitation. Such views were greatly modified following the survey of Australia's eastern coast by James Cook and the establishment of the first European settlements at Sydney Cove, in 1788, and in Tasmania, in 1803. While the newcomers found much of the terrain of the Eastern Uplands extremely rugged and, in the case of the Blue Mountains to the west of Sydney, seemingly impregnable, the lower ground, notwithstanding its unfamiliar flora, was often described as having the appearance of English parklands. Colonial artist such as Augustus Earle and Joseph Lycett painted idyllic views of open, undulating grasslands, dotted by picturesque stands of trees, and coastal scenes depicting the local sedimentary strata. The first published references to the geological character of the new colony were mainly written by civil and military officials who lacked a scientific background.

These writings expressed both awe and admiration for the massive rocky barrier of the Blue Mountains to their west, but were chiefly concerned with the search for essential and profitable earth resources. The first authoritative accounts of the continent's coastal landscapes and geology reached European readers through the publications of scientists, naturalists and artists taking part in voyages of discovery. Most notable among these was that led by Nicolas Baudin in 1801-1803. The narrative of this voyage by François Péron and Louis de Freycinet, and illustrated with the drawings by Charles-Alexandre Lesueur, gave readers a striking impression of the low, flat and desolate coasts of western and southern parts of the country, alongside views of the imposing coastal scenery and geological features on its eastern margins. The account of this voyage was translated into several European languages and excerpt from it appeared in the then popular travel literature. Following the first crossing of the Blue Mountains, some 25 years after settlement, inland exploration confirmed that most Australia was an essentially flat and featureless land. The widely read accounts of these hazardous journeys gave geologists the first intimation of the geologically very old nature of the Australian continent.

Johannes MATTES | University of Vienna, Austria

Fieldwork in the underground: cave cartography and surveying instruments at the beginning of the twentieth century

At the end of the 19th century speleology went through a radical change. Governmental organizations and private clubs were founded and tried to establish speleology as an independent scientific subject. Geological fieldwork – especially cave cartography – became a common practice in speleology and gave important hints on speleogenesis, which was still a controversial issue in the first half of the 20th century. Due to the fact that speleologists began to separate themselves from ordinary cave visitors and tourists, instruments for cave mapping like compass, clinometer and drawing board became the emblems for speleology.

Did this change in the status and nature of fieldwork have an effect on the cooperation between scientists and explorers? In what way did the usage of new surveying instruments modify the social parameters of research and perception of the subterranean world? Historic scientific papers on cave mapping and photographic glass plates from the archives of the caving clubs in Vienna and Salzburg (Austria) were used as sources for my research.

The results show that speleological fieldwork necessitated a division of labour. At least four cavers had to work together and a precisely defined task was assigned to every member. The role of cartographer, normally occupied by a leading geologist or a geological trained caver, was the only one, having the privilege of interpreting and naming the underground places. New instruments like the "Speläometer" by Spöcker (1925) became not only a fix part of the caving equipment, the connection between the scientists and the instruments required also a special training and instruction of the survey assistants. This led to an increased disciplinary action within the survey group and an identification of the scientists with the instrument.

Rather than individual perception and qualitative reports, objective data and quantifying methods became more important in speleology. Special results like the length, total depth and vertical rage of a cave were used as a scale for the social prestige of each explorer. In context of naming and "owning" of colonial territories during the imperialism period cave cartography can be seen as a part of a ritual appropriation of the underground places.

S113-F. Landscapes and meaning

Sat 27 July, 11:10–12:40 ▪ Uni Place 1.219

Chair: Cherry LEWIS | University of Bristol, United Kingdom

Ros WESTWOOD | Derbyshire County Council, United Kingdom

Derbyshire: the geological tourist destination

Eighteenth century Derbyshire may have been difficult to get to but it was a tourist destination of choice, particularly for the writers and painters of the day. While Byron was a fan: 'Was you ever in Dovedale? I assure you there are things in Derbyshire as noble as in Greece or Switzerland', Thomas Grey was less enamoured: 'I entered the Peak, a country beyond comparison uglier than any other I have seen in England, black, tedious, barren and not mountainous enough to please one with its horrors'. Even Elizabeth Bennett comes to Derbyshire to rob the county of a few spars.

The tourist route included the caverns of Castleton, the mills of the Derwent Valley and extraordinary limestone pinnacles of Dovedale, all of which remain tourist honey traps for their magnificent landscapes. Equipped with their paint boxes, wet weather gear and walking boots, these intrepid visitors ventured into the bowels of the earth, at the mercy of cavern guides to see the glittering spars and cavern formations. They stayed in hotels both good and notoriously bad (Buxton had a particularly reputation!), sampled the warm, blue, efficacious waters and purchased tourist souvenirs made from blue john and inlaid Derbyshire Black Marble. Most excitingly, these tourists sought out the new factories built to harness waterpower for the spinning industry which dominated the rivers Wye and Derwent.

This encouraged some interesting museums and entrepreneurial opportunities. It encouraged debate and discussion, so that John Whitehurst's book *On the Formation of the Earth* uses Derbyshire as his textbook example of the antiquity of the world.

On reflection, the literary record, from Charles Cotton through Erasmus Darwin and Wordsworth, may be seen as examples of the Romantic age. The technological challenge of bringing the railways through the Peak was viewed as vandalism by Ruskin, but today as Victorian engineering prowess. Re-examination of the paintings and engravings collections held in museums in the county has encouraged study of land use in the time of the Enlightenment, when Derbyshire was at the heart of a revolution of technology and innovation. Together these inform the destination management in the 21st century

This presentation will reflect on how the geology of Derbyshire inspired the writers and craftsmen, created the tourist industry with its associated hotels and tourist souvenirs pitched to the moneyed classes, and encouraged the print makers trades to thrive.

Paul KABRNA | Craven and Pendle Geological Society, United Kingdom

John Milne, 'Father of Modern Seismology': his geological and anthropological field work from 1871 to 1886

John Milne (1850 – 1913) was born and educated in Lancashire. When the family moved south his education continued as an undergraduate in the Department of Applied Sciences, King's College London. His distinguished science-based studies, in particular geology and mineralogy, helped gain him one of the coveted Royal Exhibition scholarships to the Royal School of Mines.

During 1873 and 1874 he was recruited for an expedition to assess the geology and mineral resources of Newfoundland in the employment of Cyrus Field, an American financier and entrepreneur. In between his Newfoundland commitment, Milne participated as field geologist on a three month biblical expedition sent out by the *Royal Geographical Society* to the Middle East with the intention of fixing the exact location of Mount Sinai. During his field investigation Milne collected 77 rock specimens, 22 of which were examined microscopically by Thomas Davies, F.G.S., of the British Museum. This early experience in the field provided an academic platform that would ultimately play an important part in Milne becoming Professor of Geology and Mining at the newly established Imperial College of Engineering (I.C.E.) in Tokyo.

On acceptance of his newly acquired position, two factors may have influenced Milne to travel overland to Japan via Europe, Russia, Siberia, Mongolia and China rather than boarding a steam-ship. Firstly he was prone to sea-sickness, and secondly, Milne probably saw an overland route to Tokyo as an excellent opportunity to increase his geological and mining knowledge of the different country's he would visit. At this time very little was known about the gold and copper mining regions in the Russia and Siberia that Milne made a point of visiting en-route.

During his tenure at I.C.E. the Japanese Government supported Milne's numerous field trips to all parts of their country. Between 1876 and 1880 he had visited many of Japan's volcanoes and had begun to develop a deep interest in the prehistory of the Japanese people. Milne's interest in Japan's archaeology and anthropology was stimulated by his contact with American I.C.E. colleague Professor Morse. Although Milne and Morse collaborated in excavations on Hokkaido, eventually Milne would begin to distance himself from Morse's interpretations. Many significant mineral resources were reported by Milne, particularly the large deposits of coal on Hokkaido. Milne's field work throughout Japan was deemed vital by the current government to the strengthen the foundations of their emerging nation.

From 1880 Milne had already begun dedicating his available time to elevating "seismology" from a geological pastime into a modern 'instrument-based' science. For the next 15 years he was at the centre of the new Anglo-Japanese science of seismology. Milne founded the *Seismological Society of Japan*, the first such institution of its kind in the world. Nevertheless he continued to describe Japan's geology in the societies transactions even though seismological issues were beginning to dominate his work and life.

Michiko YAJIMA | Tokyo Medical and Dental University, Japan

Disasters come when all people forget

On March 11, 2011, North Japan along the Pacific coast was afflicted by the disasters of a large earthquake and tsunami. Even now, people have still not rebuilt everything in the area. Japanese people have a saying "Disasters come when all people forget". This aphorism is said to have been introduced by Torahiko TERADA (寺田 寅彦, 1878–1935), though he is not known actually to have said it or written it. TERADA was a Japanese physicist and author, a professor of physics at Tokyo Imperial University working at the Earthquake Research Institute on a wide range of topics in physics.

As an author, Terada is best known for his numerous essays on a wide variety of topics, ranging from science to cinema, and haiku to cartoons. He studied under Sōseki NATSUME (夏目 漱石 1867–1916).

Soseki is often considered to be the foremost Japanese novelist of the Meiji Period (1868–1912). (People always call him Soseki, not Natsume.) He is best known for his novels *Sanshiro*, *Botchan*, *I Am a Cat* and his unfinished work *Light and Darkness*. He was also a student of English literature and composer of haiku. From 1984 to 2004, his portrait was on the Japanese 1000 yen note. In Japan, he is often considered the greatest writer of modern Japanese history and has had a profound effect on almost all important subsequent Japanese writers.

For Terada, Soseki was at first a teacher of English at the high school in Kumamoto but he remained one of Soseki's students throughout his life. Terada appeared in Soseki's novel *Sanshiro* as the teacher of physics, and on *I Am a Cat* as a student of the cat's owner.

When Terada got to know about Continental Drift Theory, he was greatly impressed and became interested in geophysics. He studied earthquake mechanisms and wrote many essays on natural disasters. His students all became devotees of Wegener's theory. Sakuhei FUJIWARA (1884–1950), whose work was quoted in the Wegener's book, was one of Terada's students. But among Japanese geologists more widely, Wegener's theory was not accepted, largely because the influential

geologist Hisakatsu YABE (1878–1969) rejected the theory. (But he was a palaeontologist!)

Discussion

Including closing comments from the symposium organisers.

S114. Mathematics and patronage

Sponsoring body:

ICHM: International Commission on the History of Mathematics (International Mathematical Union and DHST)

Mon 22 July, 11:00–17:30 ▪ Roscoe 1.009

Symposium organisers:

June BARROW-GREEN | Open University, United Kingdom
Reinhard SIEGMUND-SCHULTZE | University of Agder, Norway

Symposium abstract

The symposium will examine the influence of patronage on the production of mathematics from the seventeenth to the twentieth centuries. We shall consider the role and motivation of the patron (individual or institutional), the benefit for the recipient and for the benefactor, and the overall effect on the development of mathematics and its relations to bordering disciplines. We shall also be concerned with the extent to which patronage broadened accessibility to mathematical knowledge, and its effect on the mathematical community at large. Among the more general topics to be discussed are historical shifts between private and public patronage of mathematics. Considering stimuli for knowledge production outside mathematics and science proper (such as patronage) allows for a better understanding of the processes of application, i.e. for “knowledge at work” in a broad sense.

S114-A. Eighteenth and nineteenth centuries

Mon 22 July, 11:00–12:30 ▪ Roscoe 1.009

Chair: June BARROW-GREEN | Open University, United Kingdom

Niccolò GUICCIARDINI | Università degli Studi di Bergamo, Italy

Calandrini, Le Seur and Jacquier: editing Newton’s *Principia* in Geneva and Rome

I will discuss how the so-called “Jesuit edition” (1739–42) of the *Principia* attributed to Thomas Le Seur and François Jacquier was actually organized and financed by Jean-Louis Calandrini and the printer Barrillot of Genève. How could a representative of a staunch Calvinist family, prominent in Genève, cooperate with two minor Catholic friars based in Rome? Which roles Calandrini on the Swiss side, and Le Seur and Jacquier on the Roman side played? It will be shown that, contrary to what is generally believed, Calandrini wrote most of the annotations, especially those related to book 3. I will claim that the subdivision of labour between the Swiss and the minor friars reveals that they acted under different local pressures. In Switzerland the *Principia* had been attacked by prominent members of the Bernoulli family (most notably, Johann and his nephew Nicolaus). Annotating the propositions that had been criticized by the Bernoullis might have been somewhat embarrassing for Calandrini. On the other hand, one of the main

objectives of book 3 of the *Principia* was to show the truth of the Copernican hypothesis, a feature that could not be ignored in Rome, not even during the enlightened papacy of pope Lambertini (1740–1758). Annotating book 3 could not be easily done without revealing an approval for Newton’s achievement in the cosmological debate between heliocentrism and geocentrism. It seems likely that Calandrini and the minors subdivided their labour in function of exigencies determined by their association to different social contexts.

Dagmar MROZIK | Bergische Universität Wuppertal, Germany

The depiction of patronage in Jesuit mathematical frontispieces

Patronage was of great importance for the printing and distributing of books in the early modern period in several ways. Not only could a benefactor’s financial support keep an author alive and get his works into print in the first place, his messengers and, more generally, his diplomatic channels could also be used to help spread the books. In return for the patronage, or in order to commend themselves preemptively, authors often dedicated their works to the patron and/or had them included in their frontispieces. As an artistically designed graphical title page preceding the actual title page of the book, the frontispiece was thus perfectly tailored in order to represent and impress. In this talk, I would like to take a look at what this meant in the case of Jesuit mathematical textbooks and examine the depiction of patronage for some chosen examples.

Monica BLANCO | Universitat Politècnica de Catalunya, Spain

Edmund Stone and the knowledge of practical mathematics: a case study of patronage in eighteenth-century Britain

Edmund Stone (1695?–1768) was the son of a gardener at Inverary employed by John Campbell (1680–1743), second Duke of Argyll and Greenwich, and Master-General of the Ordnance from 1725 to 1740. In service of the Duke from an early age, Stone self-taught mathematics and managed to master geometry and analysis, as well as French and Latin. At the age of 18 his abilities were discovered by chance by the Duke, who provided Stone with employment that allowed him to commit himself to his studies. In 1725 Stone was elected Fellow of the Royal Society, no doubt thanks to the influence of his patron, the Duke of Argyll.

Under the patronage of the Duke, from 1723 onwards Stone published a number of mathematical works. His scientific contributions were confined mostly to translating and editing. His knowledge of French and Latin enabled him to translate several works into English. These works cannot nevertheless be regarded as mere translations. For, on the one hand, not only did Stone revise and correct the works he translated, but he also enlarged them with additions. On the other hand, there was a clear educational motivation behind his projects.

Geometry and the method of fluxions were the subjects of a first group of translations and revisions tackled by Stone. A second group was centred on practical mathematics, namely, “sphericks”, mathematical instruments, perspective, the working of ships and astronomy. In particular, in 1723 Stone translated Nicolas Bion’s work on the construction and principal uses of mathematical instruments (1716), which he dedicated to the Duke. In the translator’s preface, Stone defines mathematics both as a science (in connection with the theory) and as an art (in connection with the practice). This led him to discuss the usefulness of practical mathematics and, in turn, of the construction and use of mathematical instruments.

With regard to this second group of works, the aim of this contribution is to examine the connection between theory and practice and to explore the role played by the Duke of Argyll in the production and circulation of Stone’s works on practical mathematics.

Rosanna CRETNEY | Open University, United Kingdom

Vanité de la géométrie? Euler's experience of patronage under Frederick II of Prussia

Frederick II "the Great" of Prussia is often portrayed as a devoted patron of the arts. A polyglot and an accomplished musician, he corresponded with many of the important philosophers and intellectuals of his day. However, his views on mathematics show a completely different side of his character. Shortly after his accession to the throne in 1740, as part of his restructuring of the Berlin Academy of Sciences he employed the eminent mathematician Leonhard Euler to lead its Mathematical Class. But, though he clearly recognised the need for mathematics, Frederick's derision towards the subject did not make for a happy working relationship between Euler and his patron. Matters were not helped by incidents such as the oft-cited failure of Euler's designs for fountains at the royal palace of Sanssouci. Letters from Frederick to Euler and others reveal not only an intense dislike of Euler on a personal level, but also a petulant contempt for mathematics and mathematicians. Having such a difficult patron undoubtedly made life difficult for Euler. In this talk, I will explore some aspects of the relationship between Euler and Frederick, and investigate Frederick's role as a less than enthusiastic patron of mathematics.

S114-B. Nineteenth and twentieth centuries

Mon 22 July, 14:00–15:30 ▪ Roscoe 1.009

Chair: Niccolò GUICCIARDINI | Università degli Studi di Bergamo, Italy

Deborah KENT | Drake University, United States

Patronage and the perils of publication: mathematical journals in America, 1804-1876

The beginning of *The American Journal of Mathematics* in 1876 introduced a new model of institutionally funded mathematical research journals in the United States. Prior to that, most early nineteenth century efforts to produce mathematical periodicals in the United States hinged on editorial efforts and financial backing from a small number of individuals. The patterns of specialized mathematical publication reveal a dependence on investment and support.

June BARROW-GREEN | Open University, United Kingdom

Mathematics and patronage in Britain, 1860-1940

From the mid-19th century in Britain, the professionalization of mathematics moved ahead at a slow and gradual pace. The London Mathematical Society (1865), became established as the national mathematical society, journals such as the *Quarterly Journal of Pure and Applied Mathematics* found their feet, mathematics teachers found a voice through the Association for the Improvement of Geometrical Teaching (1871), forerunner of the Mathematical Association, and more academic positions in mathematics became available as laboratories were established and the mathematics departments of the new civic universities began to take shape. The hiatus of the First World War brought new factors into play as mathematicians helped the war effort by working in establishments such as the National Physical Laboratory and the Royal Aircraft Factory, as well as in industry. After the war, mathematicians were involved in international exchange programmes while GH Hardy, who had moved from Cambridge to Oxford for what turned out to be a temporary sojourn, tried to establish a mathematics institute in his new university but without success. For every new initiative, success or failure, the question of funding runs alongside. In this talk I examine the role of patronage, public and private in some of these initiatives and its effect on the development of mathematics and its relationship to bordering disciplines.

Reinhard SIEGMUND-SCHULTZE | University of Agder, Norway

Rockefeller patronage of international mathematics before World War Two

Within the overall process of "internationalization" of science and mathematics in the first part of the 20th century, the collaboration between foundations and mathematics had particular features. The talk will discuss them in detail at the example of support by the American Rockefeller Philanthropy in the 1920s and 1930s. Pure science, symbolized by mathematics, brought much needed social legitimacy to the Rockefeller empire via philanthropic foundations. Mathematics, in turn, received much needed money for its autonomous development which it could raise neither from the state nor from industrial enterprises, both being either bankrupt (at least the states in Europe) or more interested in immediate "applications," including elementary education.

Rolf NOSSUM | University of Agder, Norway

The Society for the Protection of Science and Learning as a patron of mathematical refugees from Nazi Germany

Following the Nazi takeover in 1933, aid organizations for academic refugees from Germany appeared in many countries. In Britain, the Academic Assistance Council, later reorganized as the Society for the Protection of Science and Learning (SPSL), was set up to cater for all branches of science and the humanities, and to assist refugees regardless of the reasons for their persecution, whether political or racial. Academic excellence was the main criterion for support from the SPSL. Other organizations, some of them British, were more limited in scope, but may have been less insistent on academic merit. The SPSL meticulously recorded all of its activities, and its archives are today accessible at the Bodleian library in Oxford. Of the 2,541 individuals on file with the SPSL during 1933-1945, 96 were mathematicians, of which 63 were from Germany and the rest from other European countries. The support rendered by the SPSL ranged from essentially nothing up to direct financial contribution to relocation and re-establishment in a British university, and letters of support for naturalization as a British citizen. Contact with other aid organizations was frequently mediated, in particular with the US Emergency Committee in Aid of Displaced Foreign Scholars, which helped resettle many European mathematicians in America. Today, the SPSL has evolved into the Council for Assisting Refugee Academics (CARA, <http://www.academic-refugees.org/>), which continues to assist academics unable to pursue their research in their countries of origin because of conflict or persecution.

S114-C. Twentieth century

Mon 22 July, 16:00–17:30 ▪ Roscoe 1.009

Chair: Reinhard SIEGMUND-SCHULTZE | University of Agder, Norway

Eileen MAGNELLO | University College London, United Kingdom

The role of the Worshipful Company of Drapers in Karl Pearson's establishment of the discipline of mathematical statistics

The energetic, enterprising and prodigious Cambridge-trained mathematician, Karl Pearson (1857-1936) received the Goldsmid Chair of Applied Mathematics at University College London (UCL) in 1984, where he taught mathematical physics to engineering students. Searching further intellectual sustenance, he became the Gresham Professor of Geometry in 1890 and attracted more than 300 students to his lectures on the geometry of statistics. These lectures subsequently provided the impetus for Pearson to set up the Biometric School at UCL in 1893, but the lack of money made it difficult to pursue his longer term goals. Ten years later, the Worshipful Company of Drapers began to provide funding for his biometric programme, which made it possible to

establish the Drapers' Biometric Laboratory. The original grant enabled Pearson to purchase some mathematical instruments and hire two permanent teaching assistants along with a team of human calculators to produce a series of tables for mathematical statistics. The longer-term aim of the Drapers' 30-year philanthropic investment was to establish the modern theory of statistics and to provide complete training in modern statistical methods when Pearson founded the Department of Applied Statistics in 1911 and set up the first ever degree course in mathematical statistics in 1917.

Anna CARLSSON-HYSLOP | Lancaster University, United Kingdom

Patronage and statistical storm surge forecasting at the Liverpool Tidal Institute, 1919-1959

Extra-tropical storm surges have long been a major cause of disasters in Northern Europe. In early 1953 over 300 people died in Britain and about 1,800 in the Netherlands in such an event. In Britain today surges are forecast using computer models produced at the National Oceanography Centre (NOC) in Liverpool. This warning system was one of the main government responses to the 1953 flood disaster and today the state is a strong patron of both day-to-day forecasting of storm surges and research into them.

However, how have such disasters been made into the concerns of British scientists and the British state? When the NOC's predecessor, the Liverpool Tidal Institute (TI), was established in 1919, its work was funded primarily by the local shipping industry. Their work on forecasting surges was done to improve the accuracy of the tidal predictions these patrons used. Only after a flood event in 1928, when 14 died in central London, did TI's surge work become about preventing flooding and was funded by local government actors. In the interwar period central government repeatedly refused to fund work into storm surges, seeing it as a local concern. Only after the 1953 event did central government become the main patron of storm surges forecasting research.

The patronage mattered for TI's science and I will discuss this in relation to their work on statistical surge forecasting and the researcher's background. During the First World War the mathematician Arthur Doodson (1890-1968) worked in one of Karl Pearson's statistical laboratories at University College London and with ballistics calculations. Doing this he developed new technologies of calculation. After the war Doodson moved to TI, where his use of calculating machines, the (then new) technology of multiple regression statistics, and methods for managing large numbers of calculations and human computers were combined with the Cambridge-style mathematics of Joseph Proudman (1888-1975). Together Doodson and Proudman changed how tidal predictions were calculated, aiming to make these more 'accurate', for example by introducing changes to tidal prediction machines and by forecasting surges.

Rita MEYER-SPASCHE | Max Planck Institute for Plasma Physics, Germany

Oscar Buneman (1913-1993), persecutions and patronages: a case study of political impact on research

Oskar Buenemann was born in Milan in 1913 with German citizenship. He obtained British citizenship in 1944 and changed his name around 1950. Political events made him move from Italy to Germany (1915 WWI) to Manchester (1935, after imprisonment by the Nazis in 1934-35) to Isle of Man and Canada (interned 1940-41) to Manchester (1941-44) and to Berkeley (1944-45, Manhattan Project). After two unattractive jobs he became *University Lecturer in Mathematics* at Cambridge in 1950 and *Prof of Electrical Engineering* at Stanford in 1960.

His emigration in 1935 shifted his mathematical interest from *pure mathematics* at U Hamburg (1932-34, goal: school teacher) to *applied mathematics* at University of Manchester. He joined Douglas Hartree's

magnetron group to develop the British radar in 1941-44. The scientific expertise he obtained in the magnetron group led him to pioneer *particle methods* and to advance *numerical analysis, plasma physics* and *electrical engineering*.

His scientific career was made possible by patronages of various institutions: When he left school as *primus omnium*, his school awarded him a scholarship for studying mathematics and sciences. After his family lost all income because of the Nazis, U Hamburg waived part of the usual fees. When Oscar and friends were arrested by the Nazis, a lawyer succeeded to remove them from an early concentration camp for a regular trial. Friends and family arranged for him admittance at the Honours School of Mathematics in Manchester, *second year*. He was the best man of the year and graduated B.Sc. in 1937, *first class in the final Honours list*. In 1937 he was awarded the *Derby Mathematical Scholarship* with *supplementary grant*. M.Sc. in 1938 and a *Beyer Fellowship*. He was interned 1940-41, while a candidate for a Ph.D. degree. When released, he got job offers in military research. But after 1945 he found it very difficult to find an *adequate position*. The situation improved when scientific societies elected him: *Member of the American Physical Society* in 1948, *Fellow of the Cambridge Philosophical Society* in 1950.

Renate TOBIES | Friedrich-Schiller-Universität Jena, Germany

Research directors and patronage in the electrical industry: the case of the mathematical consultant Iris Runge

Trained mathematicians, who could oversee or determine processes of industrial research, were relatively rare in the 1920s. Iris Runge (1888-1966) - trained in mathematics, physics, and chemistry - was the eldest daughter of the famous mathematician Carl Runge (1856-1927) and she worked as a mathematical consultant in research laboratories at electrical companies in Berlin from 1923 to 1945. Although she began working as a "physicist" at the international company OSRAM, her first research director rapidly recognized her mathematical potential. During her 22 years in industrial research, Iris Runge changed her positions from laboratories for incandescent light bulbs to laboratories for radio tubes (valves), and also from OSRAM to TELEFUNKEN. This lecture will discuss the patronage relationships that she experienced in her different positions and it will also outline the general role of mathematicians and mathematics in industrial laboratories.

S115. Mathematical knowledge at work in Ancient China

Sponsoring body:

ICHM: International Commission on the History of Mathematics (International Mathematical Union and DHST)

Tue 23 July, 09:00–15:30 • Roscoe 2.4

Symposium organisers:

Joseph DAUBEN | City University of New York, United States

Guo Shuchun | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Xu Yibao | Borough of Manhattan Community College, The City University of New York, United States

Zou Dahai | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Symposium abstract

The history of ancient Chinese mathematics and its applications has been greatly stimulated in the past few decades by remarkable

archaeological discoveries of texts from the pre-Qin and later periods that for the first time have made it possible to study in detail mathematical material from the time at which it was written. Previously, the bulk of our knowledge of ancient Chinese mathematics came from works first printed in 1084 during the Northern Song Dynasty, and through later editions and collations.

This special session will be devoted to the history of ancient Chinese mathematics, including the recent Warring States, Qin and Han bamboo mathematical texts currently being conserved and studied at Tsinghua University and Peking University in Beijing, the Yuelu Academy in Changsha, and the Hubei Museum in Wuhan. Emphasis here will be upon these recently unearthed texts and the new light they shed on the history of early mathematical thought and its applications in ancient China. Attention will also be focused on the development of techniques and justifications given for the problems that were a growing part of the corpus that eventually culminated in the comprehensive Nine Chapters on the Art of Mathematics. Contributions to this special session will serve to trace the evolution of Chinese mathematics from early texts like the *Shu* and *Suanshushu* to the commentary provided by Liu Hui for the Nine Chapters, which demonstrates the many developments mathematics underwent from the Warring States to the end of the Han dynasty, including new techniques for solving problems as well as the justifications that were given to establish the correctness of mathematical results. In the context of "Knowledge at Work," how these mathematical works were applied in the service of astronomy, surveying, state constructions projects and the day-to-day accounting that imperial administration required will also be considered.

S115-A

Tue 23 July, 09:00–10:30 • Roscoe 2.4

Chair: Joseph DAUBEN | City University of New York, United States

Guo Shuchun | Institute for the History of Natural Science, Chinese Academy of Sciences, China

战国秦汉数学简牍发现之意义刍议

近年，清华大学收藏的战国算表、岳麓书院收藏的秦简《数》、北京大学收藏的秦数学简、湖北博物馆藏的睡虎地汉数学简含有丰富的数学内容，具有极大的意义。首先，它们提供了早期中国数学史研究的不可多得的第一手资料；其次，使某些学者对中国数学的早期发展情况采取的虚无主义态度不攻自破。第三，为《九章算术》的主要数学方法和题目完成于先秦，彻底解决《九章算术》的成书这一中国数学史研究的重大问题提供了有力的佐证。更重要的，为中国传统数学的第一个高潮发生在春秋战国，提供了可靠的文献，结束了只是靠对《九章算术》及其刘徽注的分析、推理得出这两个论点的局面。

A discussion on the significance of the discovery of mathematics bamboo slips from the warring states period, Qin and Han Dynasty

The recent acquisitions of archaeological findings of bamboo slips in many institutions in China provide us a good significance for the study of development of mathematics in Ancient China.

These includes *Tsinghua University* (arithmetic table, dated from the Warring States period), *the Yuelu Academy* (bamboo slips of the book "mathematics", Qin Dynasty), *the*

Beijing University (bamboo slips of mathematics, dated in the Qin Dynasty), and *the Hubei Museum* (Han bamboo slips of mathematics at the found on "land of sleeping tiger", Han Dynasty).

Firstly, it gives us rare first-hand information on the knowledge of mathematics in Ancient China.

Secondly, it helps to clarify that the nihilistic attitude holds by some scholars on the development of early Chinese mathematics was unfounded.

Thirdly, it provided strong evidence in the study of Chinese mathematics, that the major methods and mathematics problems in *Jiuzhang Suanshu* (Nine Chapters) was completed in early Qin period.

Most importantly, it provides reliable literature to support that the first peak of mathematics achievement in China was in the Spring and Autumn and Warring States period.

In the past, the statement was only supported by the evidence of the work of *Jiuzhang Suanshu* and its explanations and remarks made by Liu Hui.

HONG Wann-Sheng | National Taiwan Normal University, Taiwan

Bamboo texts in context: a comparative study of the *Suanshushu* and the *Shu*

There are similarities and differences, in both form and content, between the *Suanshushu* and the *Shu*, the bamboo texts of Chinese mathematics in Qin-Han period. For one thing they were written or copied by low officials for their own administrative purpose. Moreover, in light of the *Jiuzhang suanshu*, both texts covered no topic like *Fangcheng*. And since the texts were written on the bamboo slip they look very similar in terms of the format. On the other hand, the *Suanshushu* contained no problems like that of the *Gou-Gu* method, which, on the contrary, were included in the *Shu*. In addition, while the classificatory terms for algorithms / formulas in the texts are also very similar, their sharing in the content is not of the same proportion. For example, problems devoted to area calculation in both texts are strikingly different. The *Suanshushu* contained only one problem under the title of *Fang-Tian*, which was actually a *Shao-Guang* problem and virtually solved by the *Yin-Bu-Zu* method. By contrast, the *Shu* collected as many as ten examples for the *Fang-Tian* method. Given these features in both the texts, this talk will be devoted to explaining their mathematical practice in the Qin-Han period. And the method of comparative history will be used in order to better understand the contextual meaning of the Qin-Han bamboo texts of mathematics.

FENG Lisheng | Tsinghua University, China

Xu Yibao | Borough of Manhattan Community College, The City University of New York, United States

The Tsinghua multiplication table

In July of 2008 an alumnus of Tsinghua University in Beijing donated 2,388 bamboo strips, along with some wooden tablets, to his alma mater. These bamboo strips, presumably stolen by robbers from an ancient tomb somewhere in mainland China, were smuggled to Hong Kong where they were sold through an antiques dealer. These bamboo strips are very important documents. A substantial number of these bamboo strips concern Chinese classics and history, but a tiny portion, 21 strips in all, are about mathematics. When put together, they form a perfect and complete multiplication table. This presentation discusses the structure of the Tsinghua multiplication table, and shows how it may be used to multiply a two-digit number by another two-digit number, and even two-digit mixed numbers with one-half by another mixed two-digit number and one-half. The table may also be used to carry out divisions and even the extraction of square roots of certain numbers. The Tsinghua multiplication table is sophisticated—it not only provides solid

evidence that the Chinese had a decimal place value system at least as early as the Warring States period (475–221 BCE), but it also indicates that mathematics had been well developed in China by the third century BCE.

Zou Dahai | Institute for the History of Natural Science, Chinese Academy of Sciences, China

The background of the problems related to foodstuffs in the Nine Chapters: a study based on the unearthed documents

The *Nine Chapters on Mathematical Procedures* is the most important classic of mathematics in China. More than a decade ago, historians of mathematics paid attention to its social background but could not obtain very significant conclusions because of lacking believable materials with definite dates. The documents on bamboo strips unearthed from ancient tombs since the middle of 1970's provide us an opportunity to investigate this subject by convincing arguments. This paper will focus on social background of the problems related to foodstuffs in the *Nine Chapters*.

These problems share the same ratios given in the list titled "rule for exchanges of foodstuffs and treated foodstuffs" at the beginning of the Chapter 2. The paper paid much attention to the relation between mathematics and law of Early China. It compares them with the *Shu* (Mathematics) on the bamboo strips of Qin Dynasty preserved in Yuelu Academy of Hu'nan University, the *Suanshushu* (book of mathematics), as well as the documents of laws on the bamboo strips of Qin and Western Han Dynasties, especially those unearthed from Shuihudi and Zhangjiashan, and finds that most ratios are the same in different documents. The author concludes that the ratios are based on the regulations of the government departments of Qin State or Qin Dynasty, and the problems were formed to meet the need of strict administration of the government and thus they primarily originated from the Qin State during Pre-Qin Period. In the meantime, a few differences among different sources show that these problems were slightly changed in the process when the *Nine Chapters* was transmitted and reedited during Qin and Han Dynasties.

Guo Shirong | Inner Mongolia Normal University, China

Applications of mathematical knowledge to military affairs in the Han dynasty of China

Materials written on bamboo slips is of great importance for the study of all things of the Han Dynasty (B.C. 206-A.D. 220), including the study of mathematics and its application. Great amount of bamboo slips of Han, which had been unearthed since 1930s, provide a lot of practical cases and problems. Detail studies on them is of great help for understudying the development of mathematics in Han dynasty.

The author of the present paper published a paper titled 'The Practical Mathematics in the Records of Frontier Military Activities in Han Dynasty' in 1989, studying some of the mathematical problems recorded in bamboo slips. Then the author studied the general mathematical materials in bamboo slips and wooden tablets in the first volume of the 'Great Series of the History of Chinese Mathematics' which was published in 1998. A great amount of new bamboo slips are discovered or published in last decade years. New study, therefore, becomes necessary.

In the present paper, we will continue the study of mathematical problems in military affairs of Han Dynasty. Based on our formal study and some new materials, we will discuss how mathematics was applied in military administration and what the importance was in military affairs in Han dynasty.

S115-B

Tue 23 July, 11:00–12:30 ▪ Roscoe 2.4

Chair: Zou Dahai | Institute for the History of Natural Science, Chinese Academy of Sciences, China

Xu Yibao | Borough of Manhattan Community College, The City University of New York, United States

The meanings of 筭 Suan in the *Jiuzhang Suanshu*

The Chinese character, 筭 Suan, appears 66 times in the text of the *Jiuzhang suanshu* 九章算术 (Nine Chapters on the Art of Mathematics), as well as in the commentaries by Liu Hui and Li Chunfeng and his associates. The character has different meanings in different contexts. It may refer to one kind of algorithm, to a type of taxation, to arithmetic, or to mathematics in general. Also, it may be used to form special mathematical terms together with other characters, for example 借筭 jie suan and 筹筭 chou suan. In Chapter 8, Fang Cheng, it appears in connection with three specific numbers: 100, 77, and 124. In this context the correct interpretation of the meaning of suan is crucial for correctly understanding the specific procedures of the Fang Cheng (Rectangular Arrays) method as stated in the original text, and as it is used in a new method provided by Liu Hui in his commentary. This presentation will offer a new interpretation of the meanings of suan in the *Nine Chapters*, and in particular, in Chapter 8.

Ji Zhigang | Shanghai Jiao Tong University, China

From everyday arithmetic to bureaucratic mathematics: a comparative analysis of the contents of 《数》, 《算数书》 and 《九章算术》

It is well known that one of the vivid signature of Chinese traditional mathematics is its sociality. In this paper, by exploring the pattern of problem and the solving method, which used in 《数》

(Numbers), 《算数书》 (Book of Numbers and Computations), and

《九章算术》 (Nine Chapters on the Art of Mathematics), we will describe the change from everyday arithmetic to bureaucratic mathematics in early Chinese mathematics.

TAMURA Makoto | Osaka Sangyo University, Japan

On the *Shu* in comparison with Qin and Han slips

The book "Shu" is one of the books of Qin bamboo slips purchased by the Yuelu Academy in December 2007, and the Academy published the report on the "Shu" in 2011 with photographs of slips. We are investigating the "Shu" based on its photographs in the same manner as our previous work on the "Suanshu-shu." In this present paper, we discuss two mathematical problems and one cultural issue of the "Shu" compared with the "Suanshu-shu" and the other book of the Qin dynasty. This paper is based upon our works in "The research group of ancient Chinese mathematics" in Japan.

1. "Quxicheng" (slips no. 32 to 34)

In this problem, hemp taxes are calculated, but the phrase "3 bu 28 cun" was not comprehensible. We compared this problem with the "Quxicheng" in the "Suanshu-shu" and obtained a complete interpretation. The phrase means that a bundle of hemp 30 cun in circumference shrinks to 28 cun when it is dried, and the purpose of this problem is to calculate the area of a field that will yield a bundle of dried hemp 30 cun in circumference.

2. "Yufang" (slips no. 67 and 68)

In this problem, a square parcel of land is divided equally between three persons, with the exclusion of a small path that crosses the land. The Yuelu Academy explains that the path is on the edge of the land and that three portions are making a line beside the path. We propose an alternative possibility as in the following: Though the area of three portions are the same, their shapes are not the same. The path pierces through the land, and after excluding the path, one of the resulting portions is assigned to one person, and the other portion, whose area is

double as large as the former's, is divided to two equal portions so that each one faces on the path.

3. Description regarding notches (slip no. 118)

On slip no. 118, there is a description "to notch ten million, thousand inside hundred; to notch hundred million, hundred on hundred." Dr. Ohkawa of our group, investigated the "Liye Qinjian" with Dr. Momiyama, Dr. Zhang Chunlong, and Dr. Hu Pingsheng, and they interpreted the meanings of "thousand inside hundred" and "hundred on hundred." There are notches on the side of many Qin slips, and the phrase explains the correspondence of shapes to values.

Jochi Shigeru | Osaka Kyoiku University, Japan

Liu Bowen | National Kaohsiung First University of Science and Technology, Taiwan

The application of Zhoubi Suanjing in Japan

Chinese astronomers observed the length of the solar shadow, knew of the winter solstice and the summer solstice and made a Chinese lunisolar calendar. They used a gnomon with a height of 8 Chi (about 240cm) because the length of the Sun's shadow would be 6 Chi at the times of the vernal equinox and the autumnal equinox, that is to say, the ratio of the right-angle triangle would be 3:4:5 in the basin of the Huang He River.

Chinese astronomers founded the observation center where the length of the solar shadow was 1.6 Chi at the time of the summer solstice. Because the gnomon was 8 Chi height, the ratio was 5:1. This right-angle triangle can be constructed from another right-angle triangle which has sides with the ratio of 5:12:13.

On the other hand, one of the oldest books about the mathematical arts of the Shu was discovered in the 21st century in the Yuelu Academy at Hunan University in China. The book was presumably written during the years of the Qin Dynasty, B.C.E. 221 — B.C.E. 206. In this book there was a right angle triangle with the ratio of 5:12:13. This indicates that ancient Chinese astronomers and mathematicians understood the nature of this triangle.

In the Eastern Han Dynasty, C.E. 25 - 220, Chinese astronomers moved to a new more southerly observation center because the length of the solar shadow on the day of the vernal equinox was computed to be 7.55 Chi, although the actual value proved to be 5.67 Chi. It was 6 Chi long on the day that was six days before the vernal equinox. The ratio of the right-angle triangle was 3:4:5.

Then the Zhoubi Suanjing was introduced to Japan at the 7th century, then Japanese mathematicians and astronomers studied it at the same condition of the Tang dynasty in China. In 731, however, Japanese emperor government made much of the Zhoubi Suanjing. If Japanese student would not pass the examination for the Zhoubi Suanjing, they would not graduate the national university. The authors thought that Japanese scholars did not make the Zhoubi Suanjing for astronomical arts, they considered this book to be a mathematics book.

Joseph DAUBEN | City University of New York, United States

The evolution of mathematics in ancient China: from the newly discovered 數 *Shu* and 算數書 *Suan shu shu* bamboo texts to the *Nine chapters on the art of mathematics*

The history of ancient Chinese mathematics and its applications has been greatly stimulated in the past few decades by remarkable archaeological discoveries of texts from the pre-Qin and later periods that for the first time have made it possible to study in detail mathematical material from the time at which it was written. By examining the recent Warring States, Qin and Han bamboo mathematical texts currently being conserved and studied at Tsinghua University and Peking University in Beijing, the Yuelu Academy in Changsha, and the Hubei Museum in Wuhan, it is possible to shed new light on the history of early mathematical thought and its applications in

ancient China. Attention will also be focused on the development of techniques and justifications given for the problems that were a growing part of the corpus that eventually culminated in the comprehensive *Nine Chapters on the Art of Mathematics*.

S115-C

Tue 23 July, 14:00–15:30 • Roscoe 2.4

Chair: Xu Yibao | Borough of Manhattan Community College, The City University of New York, United States

Donald B. WAGNER | University of Copenhagen, Denmark

Mathematics in the planning of public works in China from the first to the fourteenth century CE

Historical and mathematical texts show that fairly advanced mathematical methods were involved in the planning of public works in ancient China. It would seem that the actual design of earthworks and canals was done locally, by persons familiar with the topography, and therefore is difficult to see in the historical record, which generally focuses on the Imperial court. However the organization of the necessary labour force for very large projects was done by higher officials, often at the court level, and this we know more about. The necessary calculations included the volumes of earth to be moved, the volume production norms for groups of labourers, and the dimensions of parts of constructions to be completed by particular groups. This last often involved what in modern terminology would be called the formulation and numerical solution of quadratic and cubic equations.

An example is in the mathematical section of the 14th-century book on river conservancy *Hefang tongyi*. The dimensions and volume of a planned canal, to be dug by several groups of labourers from different counties, are given. One of the groups, with a given volume production norm, starts digging at one end of the canal, and the distance they are to dig is to be calculated. The answer is a root of the equation $15x^2 + 94500x = 11556000$. (See staff.hum.ku.dk/dbwagner/another.htm.)

An unexpected fact which emerges from this study is that in ancient China public works planning was very often done by astronomers. A question I wish to ask at the Symposium is whether this phenomenon is seen in other ancient cultures.

For the full presentation of this contribution, see:

<http://www.staff.hum.ku.dk/dbwagner/SAW/SAW.html>

Tina Su Lyn LIM | Independent scholar, Denmark

The continuation of ancient mathematics

Wang Xiaotong (late 6th–7th century AD) served the Sui and Tang dynasties in posts concerned with calendrical calculations, and presented his *Jigu suanjing* ('Continuation of Ancient Mathematics') to the Imperial court at some time after AD 626. The book consists of 20 problems, primarily concerned with problems in solid and plane geometry leading to cubic equations which are to be solved numerically by the Chinese variant of Horner's method. The problems in solid geometry give the volume of a solid and certain constraints on its dimensions, and the dimensions are required. These are phrased as practical problems. Most are solved using dissections, but Wang Xiaotong also solves a problem using reasoning about calculations with very little recourse to geometrical considerations. The *Jigu suanjing* also poses six problems concerning right-angled triangles. The solutions to four of these are derived using dissection of a 3-dimensional object. Donald B. Wagner and I have suggested an interpretation of one fragmentary comment which at first sight appears to refer to a dissection of a 4-dimensional object in a forthcoming paper on these six problems. I will give an introduction to the *Jigu suanjing* and highlight some of the most interesting aspects of the book. Preprints of our two articles are here: <http://www.staff.hum.ku.dk/dbwagner/WXT/Wang-Xiaotong-solid-geometry.htm> <http://www.staff.hum.ku.dk/dbwagner/WXT/Wang-Xiaotong-triangles.htm>

Jinyu WANG | Dunhuang Academy, China

A new discovery of mathematical texts among Dunhuang documents and its main contents

More than thirty transcripts from the Dunhuang documents have been found to associate with *Suanjing* by now. The *Suanshu* "Mathematical handbook" P.2667 had been considered as a transcript of Northern Dynasties, and the *Licheng Suanjing*-Multiplication Table of Tang Dynasty, the *Suanjing Vol. 1*, the *Tianjibiao* and *Dimuli* of Five Dynasties, and the *Yuandijibo* of Song Dynasty among them. There are ten pieces of transcripts to contain the "99" multiplication table. The ancient Tibetan transcript P.t.1256 in the French Library has an integral Multiplication Table, and the content of P.t.1070 is incomplete. A page B59 : 10 excavated from the Northern zone of the Mogao Grottoes has the double-side ink Tibetan, and it has the incomplete Multiplication Table too. The earliest Chinese digits were used in the *Licheng Suanjing*, and the *Suanjingyijuan* used them universally. Manuscripts like S.5751V0, S.12000 and P.2930 also show data copied randomly in other manuscripts. Many ancient Tibetan transcripts in the Dunhuang Museum have the page numbers of ancient Tibetan digits 0-9. In the transcript B59 : 10, the Tibetan alphanumeric and the Tibetan digits were used together, and the Chinese digits of 1-30 were written with Uighur and Sogdian at the paper back of P.t.1859A and 1869. Three pieces such as Li Shengduo 226 (Japanese Haneda 37), S.5859 and D_x3903 show some contents of the "99" multiplication table, square and division in P.3349, S.19 and S.5779 that have been identified as chapter 1 of *Suanjing*. Haneda 37 not only contains the three parts, but also is the only one which has the original width of the paper in chapter 1 of *Suanjing*. Based on textual researches, the six pieces are three transcripts. S.5859 has the following sections of lines 52-81 of P.3349, and they belong to the same transcript. The S.19 and P.3349 have the same content of lines 29-60, so they are two transcripts. D_x3903 has the following sections of lines 53-60 of S.19, and Japanese Haneda 37 has the line 26 of S.19, and the remnants of line 61. So the S.19 was separated at the line 61, and the three transcripts belong to the same one. The first 12 lines of S.5779 have the same content with the lines 100-111 of P.3349, and they don't belong to the same transcript.

Charlotte POLLET | National Tsing Hua University, Taiwan

Chinese mathematics of the first millennium AD, as reconstructed on the basis of medieval sources

The purpose of this presentation is to investigate Chinese "non-official" mathematics of the first millennium AD on the basis of the extant medieval sources. It is known that from the mid-first millennium onwards, a number of mathematical texts were used as textbooks in state educational institutions concerned mainly with administrative affairs and calendar making. But during the Song dynasty (960-1279), there existed mathematical texts not related to official education. For instance, Yang Hui, 楊輝, Qin Jiushao, 秦九韶, Li Ye, 李冶, and Zhu Shijie, 朱世杰 composed texts which were not dealing with economical and astronomical matters and were never used for state examinations. These authors referred to more ancient texts. The goal of this paper is to make the medieval treatises "speak" about their genealogy.

To do so, I propose to focus on one mathematical procedure discussed by these authors. Two of them, namely, Li Ye and Yang Hui presented the same mathematical procedure, *tiaoduan* (條段), "section of pieces [of areas]", that was used to set up algebraic equations by means of geometry. Li Ye claimed to have found his inspiration in the *Yiguji* 益古集 (Collection increasing the ancient [knowledge]), the 11th c.) and Yang Hui quoted Liu Yi's 劉益 *Yigu genyuan* 議古根源 (Discussion on the origin of the ancient [ideas and procedures]), the 10-11th c.). Both treatises are lost; one just knows from their titles that they refer to some "ancient" (古) sources. Besides, Li Ye presented an "old procedure" (舊術) used for solution of problems as opposed to the

"new" one. One has here elements for building a genealogy of methods, and I will attempt to explain the meaning of the terms "ancient" and "old" by comparing the procedures presented in these treatises. The comparative method will help to identify which parts of the texts and which elements of the procedures are to be dated of the 13th century, of the 10th century, or of the first millennium. In doing so, I hope to be able to reconstruct some features of "non-official" mathematics of the first millennium that until now has been perceived solely on the basis of the collection of treatises *Suanjing shi shu* 算經十書 used during the Tang dynasty for educational purposes.

Roger HART | Texas Southern University, United States

Tracing practices: the diffusion of linear algebra across medieval Eurasia

Linear algebra, one of the core courses in modern mathematics, has previously been asserted to have developed in "the West." Its main problem is the solution of systems of n linear equations in n unknowns. Previous accounts have attributed the origins of its two main techniques to preeminent European mathematicians, namely, Leibniz (1646-1716), for his work on determinants, and Gauss (1777-1855), for his work on elimination. Thus, although it is well known that the earliest record of what we now call Gaussian elimination is found in the Nine Chapters on the Mathematical Arts (Jiuzhang suanshu, c. 1st century CE), it has been assumed that linear algebra developed independently in the West, without any connection to developments in China. This paper presents evidence of the diffusion of linear algebra across the Eurasian continent, from early imperial China to medieval Europe. More specifically, linear algebra problems with determinantal-style solutions so distinctive that they can serve as "fingerprints" are recorded in Chinese mathematical treatises dating from the first century CE and in Fibonacci's treatises dating from the thirteenth century. More broadly, this evidence suggests the need to rethink the world history of science prior to the scientific revolution. That is, that problems this specialized, with solutions this esoteric, eventually spread across Eurasia -- including early imperial China and thirteenth-century Italy -- suggests that the assumption that other mathematical and scientific practices were not similarly transmitted should be reconsidered. To do so, we must reconsider the relationship between scientific practices, texts, and authorship during this period. Scientific practices of this period often did not depend on texts: the learning, teaching, and transmission of these practices did not require literacy; when these practices were recorded in texts, it was commonly for purposes of patronage or displays of expertise. Instead, extant texts preserve only fragmentary evidence of practices of the period. It thus makes little sense to assign credit to what we now anachronistically call "China" or "the West" based merely on the earliest known extant text in which a practice is recorded. It is likely that scientific practices circulated following routes by which commerce, art, and religion were transported by traders, missionaries, and travelers, during what is increasingly understood to be the "global Middle Ages."

S116. The history and philosophy of mathematical optimization

Sponsoring body:

ICHM: International Commission on the History of Mathematics (International Mathematical Union and DHST)

Thu 25 July, 09:10–12:40 • Uni Place 3.205

Symposium organisers:

Craig FRASER | University of Toronto, Canada

Michael STOELTZNER | University of South Carolina, United States

Symposium abstract

The idea to describe the laws of nature by means of optimal forms, by the minima or maxima of empirical measures, has fascinated mathematicians, physicists and philosophers over the centuries. Great hopes in a universal approach were followed by striking counterexamples, both having in their wake some classical philosophical controversies. The symposium will examine historical studies of optimization from the sixteenth to the twentieth century. The scope of the symposium is broad and includes the differential calculus, calculus of variations, variational mechanics and the mathematical physics of work and potential, Hamilton-Jacobi theory, linear programming, optimal control theory, optimization in economics and geometric optimization. Technical, contextual and philosophical aspects of the history of optimization will be explored.

In many areas of physical science, the investigation of optimization involves the integration of theoretical and applied concepts and techniques of solution. In fields as diverse as mechanics, thermodynamics, engineering, economics, population biology and game theory, the effective implementation of procedures based in theory is achieved using a principle of optimization.

S116-A

Thu 25 July, 09:10–10:40 • Uni Place 3.205

Chairs:

Craig FRASER | University of Toronto, Canada

Michael STOELTZNER | University of South Carolina, United States

María Rosa MASSA ESTEVE | Universitat Politècnica de Catalunya, Spain

Maxima in geometric figures in Mengoli's *Geometriae speciosa elementa*

The publication in 1591 of *In artem analyticen isagoge* by François Viète (1540–1603) constituted an important step forward in the development of a symbolic language. As Viète's work came to prominence at the beginning of the 17th century, other authors, like Pietro Mengoli (1626/7–1686), also began to consider the utility of algebraic procedures for solving all kind of problems. Mengoli followed the algebraic research of Viète in order to construct geometry of species, *Geometriae Speciosae Elementa* (1659), which allowed him to use algebra in geometry in complementary ways to solve quadrature problems.

Mengoli, like Viète, considered his algebra as a technique in which symbols are used to represent not just numbers but also values of any abstract magnitudes. He dealt with species, forms, triangular tables, quasi ratios and logarithmic ratios. However, the most innovative aspect of his work was his use of letters to work directly with the algebraic expression of the geometric figure. On the one hand, he expressed a geometric figure by an algebraic expression, in which the ordinate of the curve that determines the figure related to the abscissa by means of a proportion, thus establishing the Euclidean theory of proportions as a link between algebra and geometry. On the other hand, he showed how algebraic expression could be used to construct geometrically the ordinate at any given point. This allowed him to study geometric figures via their algebraic expressions and at the same time through triangular tables and interpolated triangular tables to derive known and unknown values for the areas of a large class of geometric figures.

In my communication, I analyze Mengoli's proof of maxima for a geometric figure in his *Geometria*, a proof that used Euclidean proportion theory and some properties of logarithms demonstrated by him. This

work illustrates Mengoli's mathematical ideas on the specific role of symbolic language as a means of expression and as an analytic tool.

ARIGA Nobumichi | National Museum of Nature and Science, Japan

Euler's principle of least 'effort': development and interpretation

Leonhard Euler's contribution to variational mechanics is commonly associated with his mathematical formulation of the principle of least action, which states that the "action" (integral of the mass multiplied by velocity along the path) is a minimum in physical processes. Although the second appendix to his *Methodus Inveniendi* (1744), where the formulation of that principle was first given, is traditionally regarded as Euler's main work in this field, historical studies have suggested that his original ideas about an optimal principle of nature were somewhat different. In this presentation I attempt to show how Euler arrived at and interpreted his own principle, which might better be called the principle of least "effort."

Euler began his study of variational principles in the early 1740s, inspired by Daniel Bernoulli. Euler found two such principles, one for elastic curves and the other for projectile motion, and published them in two appendices to his *Methodus Inveniendi*. Although Euler was convinced that nature was governed by some principle of optimization, he had no idea how to find the quantity which should be the minimum for each case. In the latter half of the 1740s, however, he recognized that any minimum quantity could be regarded as a special form of a general quantity he called "effort" (nearly corresponding to potential energy). He got this idea mainly from Maupertuis's 1740 work on statics, and confused it with Maupertuis's later works on the principle of least action. From Euler's perspective, the minimum principle in mechanics was not of "action" but of "effort," and it was more about statics than dynamics.

Statics was, as Euler conceived, the science of mechanical forces. Euler interpreted his principle of least "effort" as a consequence of the nature of those forces. The basis of this interpretation was his conception of force represented by imaginary springs, which endeavor to extend as much as possible. Euler gave such a description in his articles on the least-action principle, and it appears also in his posthumous work on statics. Moreover, Euler almost from the beginning of his career had employed such a spring-model to discuss the collision of bodies (this idea was probably inherited from Johann Bernoulli). Euler's understanding of the principle of least "effort" was, therefore, linked to his "metaphysical" conception of force, which explained why minimum properties were observed in nature.

Sandro CAPARRINI | University of Lille, France

Maxima and minima in Italian mathematics, 1770-1820

I examine how the calculus of variations is described in two bulky Italian treatises of the period: Pietro Paoli's "Elementi di algebra" (2 vols., 1794) and Vincenzo Brunacci's "Corso di matematica sublime" (4 vols., 1804-1808). In addition, research papers on variations in the "Atti dell'Accademia dei XL" and in the "Atti dell'Accademia delle Scienze di Torino" will be the subject of study. These two journals put Italy on the map for advanced mathematics in the last decades of the 18th century. Up to now, there has been no detailed study of their contents, except for some works on mechanics discussed by E. Benvenuto in his "History of Structural Mechanics"

Tinne Hoff KJELDEN | Roskilde University, Denmark

~~WITHDRAWN: The significance of duality and the question of multiple discoveries in the history of linear and nonlinear programming~~

S116-B

Thu 25 July, 11:10–12:40 • Uni Place 3.205

Chair: Maria Rosa MASSA ESTEVE | Universitat Politècnica de Catalunya, Spain

Craig FRASER | University of Toronto, Canada

Zermelo's navigation problem in the calculus of variations

Ernst Zermelo's first researches in mathematics were in the calculus of variations. His 1894 doctoral dissertation at the University of Berlin extended some of Karl Weierstrass's methods in the theory of sufficiency. In the years which followed Zermelo's interests shifted to set theory, and his contributions to this subject would prove to be of fundamental importance.

In 1930 Zermelo returned to the calculus of variations and published two papers on what became known as the navigation problem. His interest in this subject was prompted by the circumnavigation of the globe by the airship "Graf Zeppelin" in 1929. Consider a blimp or plane that moves under power with a given velocity relative to the air, travelling between two points on the earth. Because of the action of wind, the motion of the airship over land is modified. Suppose that the strength and direction of the wind are given as a function of position and time. The problem is to find the trajectory followed by the airship and the corresponding steering angle such that the airship completes its journey in the least time. Following the Hindenburg disaster of 1937, transportation by dirigibles or zeppelins became less common. In later formulations of the problem the airship was often replaced by a boat and the wind by current, and the problem was one of navigation along water.

Zermelo's solution was based on a special application of the techniques of the calculus of variations, in which he derived a result known as Zermelo's navigation formula. His result was investigated and extended in the 1930s by such researchers as Tullio Levi-Civita and Constantin Carathéodory. It should be noted that the canonical problems of the calculus of variations - the isoperimetric problem, the hanging chain, the brachistochrone - go back centuries and appear at an early stage in the history of the subject. The navigation problem is somewhat unusual in providing a simple and signature example of very recent vintage, arising from technological developments of the twentieth century.

Helmut PULTE | Ruhr-Universität Bochum, Germany

Hermann von Helmholtz on least action and 'monocyclic systems'

During his later scientific career, Hermann von Helmholtz (1821-1894) published several papers on the principle of least action and related variational principles. These papers include historical investigations about these principles and the concept of action ('Wirkung') as well as philosophical reflections on their epistemological relevance and their status within philosophy of science. In addition, Helmholtz pursued a generalization of the least action-principle for mechanics, thermodynamics and electrodynamics. The respective papers seem highly interesting with respect to his aim to achieve a unified view of theoretical physics and with respect to the 'modernisation' of mechanism in general which took place in the last three decades of the 19th century. In this context, his various "Studien zur Statik monocyclischer Systeme" (1884) and his "Ueber die physikalische Bedeutung des Princips der kleinsten Wirkung" (1886) deserve special attention.

My talk will focus on the historical origin and the philosophical relevance of the principle of least action in Helmholtz's articles in relation to his principle of energy conservation. His 'Studien' from 1884, rarely investigated until now, are reconstructed as an update of earlier attempts to eliminate the concept of force from physics by means of variational principles – an update which influenced his student Heinrich Hertz and culminated ten years later in Hertz's 'Principien der Mechanik' (1894).

Michael STOELTZNER | University of South Carolina, United States

The principle of least action as a universal guide to theory-building: Max Planck and physics around 1900

The two decades before and after 1900 saw significant progress in both variational calculus and its application to physics. On the one hand, Weierstrass and Hilbert found, for the first time, sufficient conditions for a variational principle to be minimal and provided new means to put a field often plagued by counterexamples on a secure foundation. On the other hand, almost all newly discovered physical could be formulated in terms of a variational principle or a related minimal principle. This revitalized the old belief that there was something special about these 'optimal forms', but not by focusing on what had proven so pernicious, to wit, the idea that nature minimized a physical quantity. While empiricists, among them Ernst Mach, considered this as an unjustified return to metaphysics on a mathematical basis, Max Planck tried to avoid this charge by a two-tiered strategy. On the one hand, he took up the mathematical developments arguing that a principle of least action was meaningful only once all the possible motions and the boundary conditions had been specified. On the other hand, he diagnosed that the principle had weathered all scientific revolutions by representing an abstract form that – for each new scientific theory – had to be specified by a Lagrangian and a new constant of nature, among them the velocity of light (for special relativity) and the quantum of action bearing his name (for the older quantum theory). In a philosophical perspective, Planck's move represented a return to Leibniz's contention that the principle of perfection standing behind the idea of optimal forms corresponded to a belief about the architecture of nature. Until the advent of quantum mechanics, Planck's view was highly influential on the German physics community. That it was finally abandoned, was also a product of the fact that the mathematical entities physicists initially applied to general relativity and quantum mechanics were of a different kind – even though, in the former case, such a formulation had been available since the beginning (Hilbert action) or, in the latter would be discovered two decades later (Feynman's path integral).

Adrian WÜTHRICH | Technische Universität Berlin, Germany

The role of the action function in Feynman's development of a divergence-free quantum electrodynamics

The principle of least action features prominently in Richard P. Feynman's (1918–88) alternative formulation of quantum mechanics. It is prominent in his PhD thesis (1942) and in his article "Space-Time Approach to Non-Relativistic Quantum Mechanics" (1948). As a complement to existing discussions (e.g. by Silvan Schweber 1994), I will argue that Feynman's use of the action function was characteristic of his way to solve problems. Also, I will trace the role of the action function through Feynman's subsequent work which led to his proposal of a divergence-free theory in his "Space-Time Approach to Quantum Electrodynamics" (1949).

In the framework of his PhD thesis Feynman used the action function to extend the domain of application of the traditional way of constructing quantum versions of classical theories. I see this as an instance of Feynman's characteristic heuristics of using alternative formulations for precise purposes. By divorcing the action function from its exclusive definition as the integral of a Lagrangian, Feynman was able to extend a quantization procedure, partially borrowed from Paul Dirac, to cases in which no classical Hamiltonian or Lagrangian function was available. Such cases were of interest to Feynman because, together with his supervisor John Archibald Wheeler, he had developed a divergence-free classical electrodynamics which awaited quantization. In Feynman's subsequent work, leading to his proposal of a divergence-free quantum electrodynamics, the action seems to be less important. However, the Green's functions, which Feynman then used, played almost exactly the same role as the action did in his earlier work. The slight change in focus, or maybe even only in terminology, was probably due to Feynman's war-related work where he often dealt with diffusion

processes as noted by Peter Galison (1998). The more significant change in Feynman's theoretical proposals was that he abandoned the search to justify the action or Green's function by a microscopic model following Gregory Breit (1928), Erwin Schrödinger (1930), and Dirac (1933, 1935). Instead, he made those functions the basic elements of his theory.

Jos UFFINK | University of Minnesota, United States

Extremal principles in physics

Extremum principles are abundant in theoretical physics. In this talk I will consider Gibbs' principle of maximum entropy in particular, and compare this to the principle of virtual work and the principle of least action.

I will focus on two related issues: in what respect do such principles reflect a 'tendency' of Nature, or perhaps even some teleological goal? The second issue is the status of the 'virtual' variations involved in such principles. I will argue that these might be understood as a higher-order type of counterfactuals.

S117. The institutionalization of mathematics and the founding of national societies

Sponsoring body:

ICHM: International Commission on the History of Mathematics (International Mathematical Union and DHST)

Thu 25 July, 09:00–Fri 26 July, 12:30 ▪ Roscoe 2.4

Symposium organisers:

Sérgio NOBRE | Universidade Estadual Paulista (UNESP), Brazil

Luis SARAIVA | Universidade de Lisboa, Portugal

Symposium abstract

The main aim of this symposium is to analyze and compare historical processes of the institutional organization of mathematicians whether in national or in transnational associations. The participants will put emphasis on the way in which each particular association tackled issues such as mathematics in education, research mathematics, applied mathematics, mathematics in the development of a country, the international organization and cooperation of mathematicians, and other related themes. In short, we will analyze and compare knowledge at work in the specific area of mathematics in different historical contexts, and in connection with the institutionalization of this domain of knowledge and the foundation of national societies.

To this end, we have invited a comprehensive group of distinguished historians from countries in Europe, Asia, America and Africa, and we hope for a successful symposium highly relevant to contemporary historical inquiry. We are aware that important countries have been omitted as regards mathematics, but we are limited by the number of speakers that a symposium can have in a Congress like this, and we believe that our choice allows us to have a sufficient variety of historical situations to permit the analysis of the major issues from different angles and from different historical contexts.

S117-A

Thu 25 July, 09:00–10:30 ▪ Roscoe 2.4

Chair: Luis SARAIVA | Universidade de Lisboa, Portugal

Ubiratan D'AMBROSIO | Brazilian Society for the History of Mathematics, Brazil

Institutionalization as a factor in building up mathematics as a discipline

Preliminary issues are to understand how the social and political context is a determinant of the development of knowledge and scientific ideas; and to explain why and how different individuals reveal different interests and preferences, talents, abilities and specificities in generating, organizing and sharing knowledge.

What does it mean, in different cultural settings, mathematics or philosophy or natural philosophy or religion? Disciplines are the result of the dynamic of a complex of strategies generated in response to the pulsions of survival and transcendence, both by individuals and by groups.

Although we recognize societies that were absolutely isolated – such as, for example, the Amazonian Pirahãs – we may say that, since prehistoric times, cultural encounters have always played a major role in the evolution of strategies to survive and to transcend. In every cultural encounter, we note either total acceptance or total rejection or, what is more common, syncretism. But, in any case, extant strategies to survive and to transcend play a conscious and unconscious role in further generation of knowledge.

With respect to Mathematics, the aim is to identify conceptualizations of space and time, spirituality, number, dimension, shape, symmetry and the like in many aspects of ancient and modern life, not restricted to an elite, particularly academics. A major research area is to recognize the contributions, in generating and organizing knowledge, of what is generally called invisible society. Many of these contributions are appropriated by the elite and shaped as disciplines.

A major theme in History is to understand how elites were formed in different cultural settings. A focus of this Symposium is how small elites of scholars organized themselves as National Societies, which are intellectual circles and associations, aiming at the enhancement of their common intellectual interests as individuals. This occurred all over the World and the Symposium shall address specificities of the process in different cultural environments.

The institutionalization of an informal group as a National Society helped to overcome the geographical, linguistic and cultural barriers, thus paving the way for identifying mathematics as a discipline, that is a corpus of knowledge with international agreement on beliefs, values and behaviors.

Sérgio NOBRE | Universidade Estadual Paulista (UNESP), Brazil

From a regional society to a national society: the foundation of the Brazilian Society of Mathematics

With the fundamental help of Andre Weil and Oscar Zariski, members of the Bourbaki group that, by the end of the second world war, were working at the University of São Paulo, and with the participation of some Brazilian mathematicians, the Mathematical Society of Mathematics of São Paulo was founded in 1945. Being the first mathematics society in the country, and staying unique for some years, the Society of Mathematics of São Paulo increased and assumed national relevance, until their members decided to close their activities and to found a national society. The Brazilian Society of Mathematics was founded in 1969. In this talk we will contextualize the transition of the regional society to the national society, focusing their first academic activities, emphasizing the Brazilian Colloquium of Mathematics and the first publications of this society.

Eduardo L. ORTIZ | Imperial College London, United Kingdom

Good neighbours policy and mathematics in Latin America in the 1940's

The social and political unrest in the decade of 1930s, and the Second World War, had a profound impact on the structure of international networks of scientific communication. In the 1940s these nets were redesigned according to the new realities of the world scene. This reconfiguration affected deeply the development of science and of its institutions. In this communication I consider some special circumstances that suggested, in the decade of 1940, the addition of an Inter-American branch to international scientific networks. The consolidation of this last branch had a profound effect on the perception and development of science and of its institutions, in particular of mathematics, in different countries of Latin America. I consider briefly a chain of events that started with a visit George D. Birkhoff, of Harvard University, paid to Mexico, Peru, Chile, Argentina and Uruguay, discussed in more detail elsewhere. Visits of US mathematicians, which had the support of the US Government and of the Guggenheim Foundation, continued and were later extended to Brazil. More importantly perhaps, the Guggenheim and Rockefeller Foundations contributed with their resources to facilitate study-visits of Latin American mathematicians to the US for further training. The wide group of mathematicians involved in these exchanges, the ideology and personality of the architects of this policy, and its impact on mathematics, its practice and, in particular, on its institutions in Latin America are discussed in this communication.

S117-B

Thu 25 July, 11:00–12:30 ▪ Roscoe 2.4

Chair: Sérgio NOBRE | Universidade Estadual Paulista (UNESP), Brazil

DJEBBAR Ahmed | Université Lille 1, France

Les premières sociétés mathématiques au Maghreb

Après un bref rappel historique sur les activités mathématiques au Maghreb, la communication abordera la question de la place des mathématiques dans cette région au cours de la période de la colonisation et du protectorat. Dans une seconde partie, seront exposés les éléments concernant les activités mathématiques dans la période postcoloniale et l'avènement des premières sociétés mathématiques dans un contexte politique, culturel et idéologique précis.

David ROWE | Johannes Gutenberg University, Mainz, Germany

Reassessing the influence of German mathematics on research in the United States, 1876-1914

Over the last twenty years Reinhard Siegmund-Schultze has done groundbreaking research on the reciprocal relations of the German and American mathematical communities. His work has helped produce a clearer picture of the shifting trends in research in both countries and the often marginalized role of applied mathematics in both. A fairly detailed account of the initial phase in the story can be found in the book by Parshall and Rowe from 1994. There the role of Göttingen in the special influence of Klein and Hilbert was highlighted, though with less attention paid to the impact of their respect research programs. In the present talk I will concentrate on the tradition of model making in Germany, while offering a general reassessment of its role within the research activities of American mathematicians.

Erwin NEUENSCHWANDER | Universität Zürich, Switzerland

The founding of the Swiss Mathematical Society: an episode in the institutionalization of mathematics in Switzerland

I begin by presenting some key facts about the early history of mathematics in Switzerland, e.g., mathematical teaching at the monasteries of Einsiedeln and St. Gall (9-11th century), the founding of Basel's university (following the ecumenical council 1431–1449) and its important printed editions of Euclid, Archimedes, and Diophantus, the Bernoulli family in Basel, the first chairs in mathematics in Geneva (1742) and Bern (1749), and the intensification of mathematical research during the 19th century after the foundation of the ETH (1855) and the University of Zurich (1833).

The first regular countrywide meetings of mathematicians took place in the annual congresses of the Schweizerische Naturforschende Gesellschaft (Swiss Society for Naturalists), which was founded in 1815 in Mornex near Geneva at the invitation of Henri-Albert Gosse. At the beginning of the 20th century most of the scientific sections of these congresses were upgraded to scientific societies, which gave rise to the foundation of the Swiss Mathematical Society (SMS) in 1910. The SMS normally held two meetings per year, where Swiss mathematicians presented their work to their colleagues. In the spring sessions from 1914 to 1935 the society regularly invited leading mathematicians from abroad as a way of maintaining contact with the worldwide development of mathematics; these included W. Blaschke, C. Carathéodory, E. Cartan, F. Enriques, M. Fréchet, J. Hadamard, E. Hecke, P. Montel, C. de La Vallée Poussin and H. Weyl. This pattern of individual lectures was replaced in later years by the so-called "Journées" devoted to a specialised field of mathematics, in which several invited speakers presented the newest developments in the area concerned.

In 1928 the SMS launched its own journal, the *Commentarii Mathematici Helvetici* (CMH), made possible by a subsidy from the Swiss government. The CMH attracted many important mathematical papers and created a measure of independence that allowed Swiss mathematicians to publish their work in their own country during World War II. In 1976 the SMS also took over the editorship of the more generally oriented *Elemente der Mathematik*, a journal founded in 1946 by the SMS member Louis Locher-Ernst. Switzerland also hosted three International Mathematical Congresses, in 1897, 1932, and 1994. They attracted, respectively, 208, 667, and 2,536 mathematicians from all over the world. The SMS was highly influential in organizing these congresses, and has also always administered the Swiss National Committee representing our country in the General Assembly of the International Mathematical Union (IMU). From 1955 to 1986 the SMS and the Swiss Universities often provided the president or secretary of the IMU (H. Hopf, R. Nevanlinna, G. de Rham, B. Eckmann, K. Chandrasekharan, J. Moser). For further information see E. Neuenschwander, 100 Jahre Schweizerische Mathematische Gesellschaft, in: B. Colbois, Ch. Riedtmann, V. Schroeder (eds.), *math.ch/100*, EMS Publishing House 2010, p. 23-105 (www.math.ch) and the article "Mathematik" in the *Historisches Lexikon der Schweiz* (www.hls.ch).

S117-C

Fri 26 July, 09:00–10:30 ▪ Roscoe 2.4

Chair: Tatsuhiko KOBAYASHI | Maebashi Institute of Technology, Japan

Martin ANDLER | Université de Versailles St-Quentin, France

The creation of the Société mathématique de France in 1872

The creation of the French mathematical society in 1872 comes at the beginning of a period of radical change in the French system of higher education. During the most part of the XIXth century, the dominant institution for mathematics was the *Ecole polytechnique*, while universities and the *Ecole normale supérieure* played no significant role, particularly for training research mathematicians. However, starting in the 1850's, *Polytechnique* graduates became less and less interested in the advancement of science, while the *Ecole normale supérieure*, under

the impulse of Louis Pasteur who became its director of studies in 1857, became the preferred option for those students who would become mathematicians.

The bitter defeat in the war against Prussia in 1871, after which France lost Alsace and part of Lorraine, led public intellectuals to the conclusion that the defeat was due to the inferiority of French universities compared with their German counterparts. As a result, French national government invested large amounts to bring universities to life, through new constructions and the creation of professorial chairs.

The combination of public policies and a push for renovation coming from within Academia turned the situation of French universities around ; in mathematics this manifested itself by the emergence of a spectacular new generation of mathematicians : Darboux, Poincaré, Picard, Hadamard, Cartan, Borel, Lebesgue to name but a few ; all of them are "normaliens" except Poincaré.

When the *Société mathématique de France* (SMF) is created in 1872, the older generation of "polytechniciens" is still at the helm. Michel Chasles (1793-1880), a graduate of the *Polytechnique*, and still a professor at the *Sorbonne* becomes the first president of the new society. Remembering that the *Polytechnique* is an engineering school (several of the most distinguished research mathematicians who are graduates of the *Polytechnique* hold engineering rather than academic positions) it is not surprising that the weight of engineers and teachers in the membership of SMF is strong. By 1900, the weight of frontier researchers, graduates of the *Ecole normale*, in the society has become dominant.

Umberto BOTTAZZINI | Università degli Studi di Milano, Italy

From the Circolo Matematico di Palermo (1884) to the Unione Matematica Italiana (1922): contrasting views on the institutionalization of mathematics in Italy

With respect to other mathematical communities in Europe, and United States, the Italian mathematical community founded its national society - the *Unione matematica Italiana* - rather late, in 1922. However, since 1884 in Italy a mathematical society, the *Circolo matematico di Palermo*, had been founded by G. B. Guccia. The *Circolo* quickly acquired an increasing national, and international relevance due above all to its journal, the *Rendiconti*.

In the talk I will discuss the raising (and contrasted) role of the *Circolo* in the Italian mathematical community up to WWI. In the post-war climate, the death of Guccia coupled with the rise of nationalism in science led to the crisis of the *Circolo* as an international society, and the need felt by V. Volterra of founding a truly national mathematical society , the *Unione Matematica Italiana*.

Luis ESPAÑOL | University of La Rioja, Spain

The founding of the Spanish Mathematical Society in 1911, and several subsequent re-foundings

When the 20th century began, the renovation or foundation of institutions for the advancement of science, mathematics in particular, was promoted in Spain:

1900: Ministry of Public Instruction. Educational reform

1907: Board for Advanced Studies and Scientific Research (Spanish acronym JAE)

1908: Spanish Association for the Advancement of Science (AEPPC)

1911: Spanish Mathematical Society (SME)

1915: Mathematical Laboratory and Seminar of the JAE

The Royal Spanish Mathematical Society (RSME, at its beginnings SME) celebrated its first centenary with numerous activities throughout the year 2011, including the publication of the book *History of the Royal*

Spanish Mathematical Society (in Spanish) written by L. Español. It contains *Preamble: Before the RSME*, where E. Ausejo, F. Veá and M.A. Velamazán collaborate with the author to briefly describe the institutional context prior to the founding of the RSME. During the last third of the 19th century the Spanish mathematical community was poorly developed and most of its members were either civil engineers or military of the technical specialties of the Army and Navy. Mathematics teachers of high school and university were becoming more numerous but had less social influence than engineers and military. In founding the RSME they played an important role three professionals in the capital Madrid: the military M. Benitez, who proposed at the first congress of the AEPPC the establishment of the Society, the engineer J. Echegaray, who was its first president, and the full professor C. Jiménez, who was the first director of the social journal *Revista de la SME*.

Over the years, the evolution of Spanish society and its community of mathematicians led the RSME to crisis of varying lengths that ended with a kind of refounding:

1919: First refounding guided by J. Rey Pastor, after the crisis held in 1917.

1941: Refounding by the Dictatorship, after the Civil War 1936-39.

1961: Refounding in parallel to the First Development Plan, after a generational crisis.

1997: Last refounding, after a deep crisis that began in 1990.

The aim of my contribution is to draw a selective picture of the RSME's history focused on its founding and the refoundings which have occurred over its first hundred years of life.

Luis SARAIVA | Universidade de Lisboa, Portugal

The beginnings of the Portuguese Society of Mathematics, 1936-1945

The Portuguese Society of Mathematics was founded in December 1940 by a group of mathematicians who had two main aims. On the one hand, they wished to introduce to Portugal those areas of research that were of interest in other countries at the time. On the other, they wished to publicise these new areas and to revitalise Portuguese Mathematics by capturing the interest of university and pre-university youth.

In this talk we will contextualize the coming of age of this generation of mathematicians, known in Portugal as "the 40s generation". We will analyze several aspects of their work, including the journal *Portugaliae Mathematica*, the *Mathematics Gazette*, the foundation of the *Portuguese Society of Mathematics* and its first years of activities. Our analysis is only made for the period 1936-1945, a crucial period of change in what concerns mathematical activity as an institutionalised practice. Concerning mathematical developments, this is the most interesting period of this age in Portugal, and it coincides with the stay in this country of António Monteiro after his return from Paris, where he completed his PhD under the supervision of Maurice Fréchet. Monteiro is the decisive figure of this time and the one behind most of the important mathematical innovations in Portugal in the first half of the 20th century.

S117-D

Fri 26 July, 11:00–12:30 ▪ Roscoe 2.4

Chair: DJEBBAR Ahmed | Université Lille 1, France

Christine PHILI | National Technical University of Athens, Greece

The University of Athens: a cradle for the development of the mathematical community in Greece

Although the Ionian Academy in Corfou (1824) and the Military School in Nafplion (1828) were both the first institutions of a higher education ,

the establishment of the University of Athens founded by king Otto in 1837, denoted the beginning of the higher education in Greece.

For many decades the mathematical department was the "poor parent" of the faculty of philosophy, the fourth among these of: theology, medicine and law. Nevertheless the lectures delivered by distinguished professors educated in Europe could compensate this handicap. The first professors of mathematics K. Negris and G. Vouris from the *Ecole Polytechnique* and the *University of Vienna* respectively tried to initiate the few students in mathematical science, although the lack of manuals made their task difficult. Later V. Lacon and N. Nicolaidis prepared the way for the creation of the first mathematical school founded by I. Hadjidakis and C. Stephanos. Thus at the turn of the 19th century started to take shape the mathematical community by publishing its research in distinguished European journals such as *the Comptes Rendus of the Academy of Science in Paris* or the *journal of Crelle*. Moreover the publication of instructive books for three levels of education also contributed to the expansion of mathematical knowledge at the first two levels as well as to introduce in Greece at a third level contemporary theories. In 1904, when the physics-mathematics department acquired its autonomy, the inauguration of seminars organized by N. Hadjidakis, expanded the horizon of the students. As for the International Congresses until 1912 the presence of Cyparissos Stephanos assured the Greek representation at that period. During the fifth International Congress for mathematicians in Cambridge the Greek delegation was composed by the new generation of mathematicians who designated their entry into the international scientific community.

Liu Dun | Chinese Academy of Sciences, China

The Chinese Mathematical Society and mathematics in modern China

The transition from traditional mathematics to modern one in China started at the end of the 19th century. By the beginning of the 20th Century, with the diffusion of Western sciences in China and the return of overseas Chinese students, modern math-teaching and math-research had gradually developed, and some regional math societies also emerged.

Chinese Mathematical Society (CMS) held at Shanghai its inaugural and first annual conference in 1935. The establishment of the CMS and the publication of its journals are landmarks in modern math development in China. Unfortunately, in subsequent Anti-Japanese War (WWII) and the Civil War, CMS activities were forced to suspend, although a few scientists persisted in academic activities under very difficult conditions.

The development of modern math in China and that of the Society took off following the founding of the People's Republic of China, when the Society revived its activities. Between August 15 and 20, 1951, the first national conference was held at Beijing University. Two more successive national conferences were held in Shanghai in February 1960 and in Chengdu in November 1978. Hua Luogeng (Hua Loo-keng) was the president of the first three terms of the new society. The exceptional achievements made by contemporary Chinese mathematicians include: Hua Luogeng: analytic number theory, typical group, multi-complex function theory; Wu Wenjun: algebraic topology—Wu class and the Wu formula, automated theorem proving; Feng Kang: computational mathematics—the finite element method; and Chen Jingrun: number theory—Goldbach conjecture.

During the Cultural Revolution (1966-1976), the Society ceased its activities. Research by mathematicians was forced to suspend and Chinese mathematics ground to a halt.

Since 1977 especially after the reform and opening-up, modern Chinese math and the CMS met with a golden opportunity for development. Specialty and local branches were established, with the CMS working committees improved and optimized. Currently, the CMS is active in the following areas: national organization of academic exchanges; compilation and publication of mathematical journals; international academic exchanges; math contest, popularization and diffusion;

promotion of math education reform; and organizing training classes or symposia in accordance with national needs and educational requirements.

This presentation is based on work co-authored by Gang Hou.

Tatsuhiko KOBAYASHI | Maebashi Institute of Technology, Japan

The conversion from Wa-san (pre-modern Japanese mathematics) to Yo-san (western mathematics)

Original mathematics called *Wa-san* was developed in Japan during the *Edo* period (1603~1867). *Wa-san* has its root in ancient Chinese mathematics, so it has a completely different form and notation etc. from Western mathematics. Pre-modern Japanese mathematicians, who were called *Wasan-ka*, however, have made a great advance in algebra, geometry and integral calculus. The study of integral calculus in Japan before modernization differed from its Western form, and was uniquely materialized independently from physical phenomenon. Japanese of the *Edo* period loved mathematics supremely; the environment where mathematics was studied spread everywhere in Japan.

Tokugawa bakufu government collapsed in 1867. It meant that the *Edo* period ended and the *Meiji* period begun. The new *Meiji* government changed the conventional education system as part of the modernization campaign of a country, and in order to introduce Occidental modern education, it established the Ministry of Education in 1874. An Investigation Committee of the education system was organized by the Ministry of Education and started discussion on the system of public school in the latter half of this year. Then the government ordinance on reform of the schools system and its curriculum was stated in 1872. It was named "*Gakusei*" In this declaration the new *Meiji* government said that *Wa-san* (pre-modern Japanese mathematics) was abandoned in elementary school and instead *Yo-san* (western mathematics) was adapted. This decision meant the expulsion of traditional mathematics from public education.

In 1877, the University of Tokyo was established. It means that modern higher education has begun in *Meiji* Japan officially. Dairoku Kikuchi (1855-1917) was the first appointed mathematics professor. He studied in Britain in two periods, 1867 and 1870, and went back in 1877 to occupy his position in the University. Tokyo mathematical society was established by *Wasan-ka* and *Yosan-ka* in 1877. A magazine of Tokyo mathematical society was published in same year with the aim of popularizing mathematics among the public. Those movements mean that western mathematics was formally accepted in Japanese society, and it also meant a start of its popularization.

In this symposium we will discuss the process of conversion from *Wa-san* to *Yo-san* at the beginning of the *Meiji* period.

P119. Everlasting bath: the history of sauna technology and culture

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Sat 27 July, 09:10–12:40 ▪ Schuster Moseley

Symposium organisers:

Henrik BJÖRCK | University of Gothenburg, Sweden

Timo MYLLYNTAUS | University of Turku, Finland

Symposium abstract

In the hectic modern world, we tend to believe that our way of life is modern and our customs date from fairly recent times. We suppose that nearly everything has changed since the Middle Ages and technological development has reshuffled our life style completely, forcing the rejection of practically all traces to the antiquity. Technology is often considered a mighty enemy of traditions. Nevertheless, there is at least one outstanding exception to this pattern: saunas.

Several millennia ago, Native Americans bathed in sweat lodges and steam bathhouses were common throughout Europe. In fact, steam baths were quite common all around the northern hemisphere until the Middle Ages, when authorities banned public bathhouses in Central Europe in order to prevent the spread of infectious diseases. Nevertheless, the steam bathhouse tradition still stayed in tact in the sparsely populated eastern peripheries of Europe—from Turkey and Bulgaria to Estonia, Russia and Finland. As the result, this ancient bathing tradition has remained more common in cold and forested Finland than in any other country, and there are almost as many saunas as cars: one sauna per two inhabitants. Actually, the Finnish sauna has become the traditional model for steam bathhouses, although there are considerable cultural and national variations in building constructions and heating technology.

During the past eight millennia, building materials, construction techniques, and styles of housing have changed several times. However, these changes have not led to the exclusion of steam baths from everyday life in various eastern European countries. On the contrary, technology has been used to modify physical features of these bath institutions to fit the current construction conventions and social demands. Thus, over the course of millennia, saunas have changed, but they have not vanished. Basic elements of saunas have remained, and the pleasure of bathing has been preserved.

The sauna is a case in point in how an ancient cultural habit can be persistent in a changing world, and how technology has been used to preserve a prehistoric custom with constant innovation and modification.

This session will examine and discuss the persistence of sauna culture and the malleability of technology in adapting steam baths to the changing requirements of bathers. Can we find technological determinism or technological momentum in the history of the sauna? If there is path dependence in this case study, is it technological or cultural? The session also aims to analyse why the sauna has preserved its attraction, while life styles have completely changed during millennia and new bathing options have become available.

P119-A. Technological basis and social context

Sat 27 July, 09:10–10:40 • Schuster Moseley

Session organiser: **Timo MYLLYNTAUS** | University of Turku, Finland

Chair: **Päivi Maria PIHLAJA** | University of Helsinki, Finland
Timo MYLLYNTAUS | University of Turku, Finland

The resilient attraction of the Finnish sauna

The sauna is outdated as a bath institution, or so many could claim. While, nowadays, modern alternatives are available that are less-time consuming, smaller, much cheaper and also more environment-friendly. The sauna is an example of an archaic institution and technology that is no longer necessary for the utmost rational or practical reasons. Nevertheless, it has preserved its popularity for millennia, despite profound societal and cultural changes. The Finnish sauna is just one type of the still existing hot steam baths in the world. Steam baths' success has not been universal, but they have gained a firm status in some cultures and a few countries. This paper examines why the sauna and other steam baths have managed to preserve their attraction and popularity from primitive to modern societies, and why they have

succeeded in becoming stable and persistent cultural institutions. Fashions have changed the sauna, but they have not displaced it.

The paper examines the causes of the sauna's resilient attraction on the basis of arguments presented in public discussions. Firstly, it is a commonplace to suppose that the sauna's status is based on its versatile qualities as a bathing institution. It is true that frequent users primarily go to the sauna only to wash themselves. However, the sauna has other attractions, as well. Secondly, bathing in a sauna is a social event; Finns feel like orphans sitting alone in a sauna. Thirdly, sauna bathing is claimed to be a relaxing experience. Fourthly, discussions about the healthiness of sauna baths have persisted, with arguments both in favour and against it. However, in this respect most people rely on their personal experience. Fifthly, while perhaps subconsciously, many frequent sauna bathers consider a sauna bath as a purification ritual: cleaning both the body and the soul. This belief is embodied in the sauna culture: one is thought to be a better person mentally and physically after a bath than before it.

While Finns do not believe the healing effects are long lasting, even short-term benefits are satisfying, and repeating the therapy session would be considered just another moment of pleasure. While the sauna as a physical space is not a holy place for Finns, it has been possible to modify it according to various requirements. My hypothesis is that with different technological and architectural solutions, the same therapeutic or spiritual experience of the sauna can be achieved. Furthermore I argue that the sauna is not only a bathing institution, but also something more: sauna experiences appeal to primitive instincts of the human mind.

Pekka LEIMU | University of Turku, European Ethnology, Finland

The international Finnish sauna

The sauna is usually considered a Finnish phenomenon. However, six centuries ago, the hot steam bath was still known throughout the entire coniferous zone of Eurasia. Nowadays, only Estonians, Russians and Turks have a living national sauna culture; elsewhere in Europe, national hot steam bathing cultures have died out.

During the last decades the sauna has begun to spread again to central Europe and even to Japan and the US, where it was previously unknown. For example, according to the International Sauna Society, whose headquarters is in Helsinki, there are more than 5 million people in Germany and more than 12 million people in Japan who take sauna baths regularly. So, in both countries, there are more bathers than in Finland, which has only 5 million inhabitants, almost all of which use the sauna weekly. While Finnish saunas serve as the model, saunas abroad are usually different from those in Finland. How did the Finnish sauna spread to other countries? There were three ways: firstly by the migration of people, secondly by exports of sauna buildings or equipment, and thirdly by mass media.

In other countries, saunas are mostly owned by sauna clubs or commercial companies, contrary to the private family saunas of Finland. Also, public saunas in other countries are usually intended for both sexes, also contrary to Finland. The owners abroad argue that, otherwise, their saunas would become places for sexual minorities. Finally, unlike in Finland, sauna bathing is strictly regulated in other countries, because the owners claim that only Finns understand how to use them properly, having learned to take sauna baths as children.

Although Estonians and Russians do not need regulations on how to behave in a sauna, strictly regulated bathing cultures abroad gave us an idea for a research project. In 1993 the Finnish Sauna Society in Helsinki and the Department of European Ethnology at Turku University carried out a nationwide survey, inquiring "how did I learn to take a sauna bath?" This question was the only one in the whole questionnaire, and respondents were given the opportunity to answer in their own words in Finnish or Swedish. We received 1040 responses about people's

adoption of sauna culture, and these results are summarised in this paper.

During the twentieth century, Finland became urbanized, industrialized, and modernized. When people moved from the countryside to cities or industrial communities to work in factories, they took their private saunas with them. But the sauna had to be modernized to fit in the new surroundings. This was done by Finnish architects and engineers.

Henrik BJÖRCK | University of Gothenburg, Sweden

A proper bath for the people: the public baths movement in Sweden and contending views on sauna design

Focus in this presentation is on the interplay between the articulation of the private hygiene of citizens as a social problem, on the one hand, and the proposing of practical solutions to the identified problem, on the other.

"The bath issue" may today sound as something odd, but signified a reality in the growing cities of Swedish society in the later 19th century. Bacteriology as a new way of understanding sickness contributed to making hygiene into a key factor for health on both the individual and societal level. After the articulation of the general problem by medical professionals, municipal politicians and national social policy makers contributed to making "the bath issue" into a part of the over-arching "social issue" around the turn of the century. It was related to "the housing issue" and had the absence of bath-rooms as a starting point. To promote the goal of "a clean people" then came means in the form of, e.g., publically funded bath-houses created by municipal engineers. One problem for bathing reformists was the people's lack of interest and understanding of their own good.

This Swedish trajectory fits into an international pattern. Taking the 1899 founded *Deutsche Gesellschaft für Volksbäder* as a model, actors from the realms of medicine, social policy, municipal engineering in 1921 founded The Association for Public Baths. The focus initially was urban, but soon interest was redirected towards the countryside, where saunas were seen as the feasible solution of the rural bath issue. The Association collaborated with the State Pension Board and came to channel funding to local actors who wanted to build houses for bathing; these had to be of solid construction to be approved by the Association's experts and get state funding. At the second Bathing Congress in Stockholm 1930, this orientation of activities was challenged. The Swedish Gymnastics Federation argued that distance was the problem in rural areas and that a bath had to be in reach for people to be used; as the houses for bathing had to be many, they had to be simple and cheap. The contending views on the proper bath for the people had immediate implications for sauna design. This controversy came to follow the public baths movement, but eventually became irrelevant when the rising housing-standard paved way for private solutions.

P119-B. Cultural heritage and scientific knowledge

Sat 27 July, 11:10–12:40 ▪ Schuster Moseley

Session organiser: Timo MYLLYNTAUS | University of Turku, Finland

Chair: Timo MYLLYNTAUS | University of Turku, Finland

Kimmo KÄNSÄLÄ | University of Helsinki, Finland

The sacred bath: Finnish sauna as liminal space

In my thesis in comparative religion, I researched the sauna as a sacred place and a national symbol. There is ample textual and ethnographic evidence that sauna has been considered in Finnish history a holy place, and a location for otherworldly encounters in people's minds. The starting hypothesis of the study is that these events are connected with the action of "having a sauna" (*saunominen*), i.e. going to the sauna and

bathing, which has become ritualised. This has resulted in sauna having a special significance in people's minds, and that sauna has become a sort of national symbol and a major part of Finnish everyday life and culture partly because of this.

The research material consists of textual materials from the folklore archives of Finnish Literature Society and interviews done with members of the Finnish Sauna Society. The former works as orientating material and the latter offers a possibility for deeper discussions about issues rising from the archive material.

To analyse the material I use the theory of the 'sacred' as formed by Veikko Anttonen. It focuses on the borderline aspect of sacred and is based on three concepts which direct human thought and action: body, society and territory. The analysis consist of three themes which discuss the different interconnected aspects of the material. 1) *The Body* focuses on the bodily aspect of the sauna, including the written and unwritten rules concerning nudity and general behaviour in sauna. 2) *The Communitas* focuses on the liminality of the sauna: the harmonious feeling, the notion of equality among other people in sauna, etc. 3) *The Territory* focuses on how the mind works at the borders of differing categories, and how cognitive functions "canalize" cultural habits. The ritualisation of going to sauna seems to be actualised especially in the practise of inviting guests, especially foreign people, to the sauna.

I argue that sauna still has a sacred status in people's minds, even though going to sauna has become largely secularised, as compared to ancient traditions. Researching people with a considerable enthusiasm about sauna seems to suggest that the notion of sacredness is still evident in Finnish sauna; there is enough evidence to argue that going to sauna is ritualised for some people and in certain contexts. If this has resulted in sauna having become a national symbol is, of course, impossible to "prove", but I merely argue that there might be a connection with the pre-Christian meanings of the 'sacred', ritualisation, and our current attitude towards sauna.

Laura PUOMIES | University of Turku, Finland

Preserve of the heritage or enthuse over new innovations

"There is at least one thing, which is done as always before: having a sauna bath every Saturday evening. It gives a feeling of safety and for adults wakens up nice memories."

The sauna has survived cultural revolutions and retained its central position in the cultural heritage of Finland. This can be explained in two ways. Either the sauna's heritage is so flexible that it has changed with cultural revolutions, or the sauna has kept its traditional value so desirable that its traditional model has managed to keep its position as an important way of taking a bath.

In this paper I explore the values that have been ascribed to the sauna both in oral tradition and in modern advertisements about the sauna. Do these two portrayals of the sauna convey the same values, and are they in favour of innovations or against them? And how have the innovations been justified: are they only new simulations of the ancient way of having a sauna bath, or do they invent a totally new bathing style?

I presume that both the traditional sauna and the modern sauna using new technology can live side by side. The sauna's attraction is based on senses, emotions, and aesthetic experiences. Both the traditional and modern saunas can provide those elements for people.

In my analysis, I give special attention to the sauna's exceptional aesthetics, where the past, present, and future meet in sauna bathers' sensitive awareness. Sometimes only a detail or a reminder of the traditional sauna is needed to satisfy sauna bathers' yearning for nostalgic experiences.

"Is the sauna healthy? Nobody ever asked that. The whole question is rough. Are joy, happiness, and smiling healthy? To reach these, people have taken bigger risks than taking a sauna bath."

(The quotes are from the oral tradition research material and I shall use them in this paper.)

Päivi Maria PIHLAJA | University of Helsinki, Finland

“Put a man into a close, warm place”: living laboratories of early modern empiricists and their philosophical implications

The paper seeks to explore the meanings attached to the sauna in eighteenth-century scholarly discussions concerning the character and physiology of Man. The aim is to explain the surprisingly frequent references in eighteenth-century scholarly writings. The sauna, it will be argued, was perceived by scholars as a 'living laboratory' where the physiological mechanisms determining spiritual and scientific abilities of men could be assessed and principles of political philosophy tested in an isolated environment.

In the Eighteenth Century, the age-old climate theory (presumption that the spirit and disposition of men varied depending on the climate and other physical surroundings) was put to the test of empirical method. The philosophers were looking for concrete evidence to understand how body and human senses responded to cold and heat. The results were extended to explain presumed differences in national character. "*Mettez un homme dans un lieu chaud et enfermé*", wrote Montesquieu, invoking thus a sauna-like space as a testing ground for his ideas concerning the effects of heat on the fibres and nerves of the human body which formed the basis for his political theory.

In the same vein, travellers to the northern countries – as well as philosophers who read their accounts – paid close attention to the practise of sauna. A great difference of temperature between the warmed rooms and the cold climate was considered an excellent circumstance for studying the physiological and spiritual constituents of men. Nordic scholars soon realised that the sauna could be utilised as a scientific resource, and ordinary custom of bathing was mobilised for systematic experimentation. Men and women of various ages were marched in; and the effects on their body temperature, length of their limbs and other 'symptoms' were closely monitored, measured, and transcribed into tables. For the northerners, the conclusions drawn from these experiments had also sensitive symbolic meanings, since the climate theories had traditionally articulated strong prejudices towards the scientific potential of the northern regions.

By examining the thoughts which the sauna evoked in eighteenth-century scholars and philosophers, this paper seeks also to explore the scientific practises of the Eighteenth Century and to shed light to the patriotic functions attached with empirical science.

P120. Eighth annual symposium on the social history of military technology, incorporating the Gunpowder Study Group

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Wed 24 July, 09:10–Fri 26 July, 12:40 ▪ Schuster Moseley

Symposium organisers:

Barton C. HACKER | Smithsonian Institution, United States
Ciro PAOLETTI | Commissione Italiana di Storia Militare, Italy

Symposium abstract

Since 2006, the annual ICOHTEC symposium on the social history of military technology has sought to expand the subject from its usual emphasis on detailing weapons development and use to the broader goal of setting military technological change in its largest social and cultural settings.

P120-A. Premodern military technology

Wed 24 July, 09:10–10:40 ▪ Schuster Moseley

Chair: Barton C. HACKER | Smithsonian Institution, United States

Harry RAND | National Museum of American History, Smithsonian Institution, United States

What was the Trojan horse?

Weapons of war are often given names that recall the most aggressive traits of animals. In the ages before chemistry unleashed the power of rapid oxidation (for turbines, internal combustion engines, rockets, and explosives) the muscle power of brute force, supplied by men or beasts, was the supreme measure of potential and possible accomplishment in warfare. Unsurprisingly, the bravest animals and their most aggressive and brutish behavior suggested the names for weapons. Perhaps the horse gave its name to a weapon, at a time when horses were not viewed as primarily amicable but potentially wild creatures whose feral qualities were vividly remembered by those who had only recently domesticated them.

Today they are mostly symbolically untamed, as few actually encounter wild horses. Long ago, before they were regarded as beautifully graceful, swift companions imagined to be faithful, before they were domesticated, horses were savage, were big game to be hunted and eaten when they could be caught at all—as shown on walls painted by salubrious artists in Franco-Cantabrian caves. Their image, as anything but docile, as powerful beasts persisted for tens of thousands of years. Their prehistoric reputation survived into the age of literacy and was recorded in our culture's central narratives. When God mocks humanity's puny status, the fierce poetry of *Job* captures the lingering image of the horse, surely a neolithic recollection perduring into the age of literacy:

Have you given the horse its strength? Have you clothed his neck with thunder? Can you make him afraid as a grasshopper? The glory of his nostrils is terrible. He paws in the valley, and rejoices in his strength.

Over time the story of what occurred before the walls of Troy kept its overall shape, that a large artificial horse was used to enter Troy and within it was a squadron of Greeks. But over time and with distance from the events the story's technology became garbled. This may seem strange as Homer is renowned for the precision of his observations, but Homer did not record this event, a lesser poet did. The Trojan Horse is not mentioned in the *Iliad*, which describes the ten-year's siege of Troy. Yet, it is possible, over this vast distance, to determine what weapon breached the walls of Troy and was called a "horse".

Jorit WINTJES | Julius-Maximilians-Universität Würzburg, Germany

Technology with an impact: the introduction of artillery in ancient warfare

The end of the 5th c. BC saw one of the most important technological advances in the military history of antiquity - the introduction of artillery in various forms, which was at first mainly used in the context of siege warfare, but soon found employment on the battlefield as well. Ranging from small pieces with a two-men crew to huge contraptions capable of firing stone balls of 50lbs or more, artillery had a significant impact on key aspects of ancient warfare - the most obvious being the development of highly complex fortifications rivalling early artillery fortifications of the 15th and 16th c.

However, while the purely technological aspects of ancient artillery have seen considerable scholarly attention in the past - from the edition of ancient treatises on artillery to the reconstruction of various artillery pieces - other key issues have so far been neglected; therefore, the proposed paper will concentrate on three main points:

One - the introduction of artillery had a direct effect on the logistics of ancient armies; artillery pieces were cumbersome yet delicate, not exactly easy to transport and in many cases needed manufactured ammunition. As the number of artillery pieces employed by ancient armies rose, so did the logistical problems facing their commanders. Two - employing artillery on the battlefield, in the fire support role during an amphibious landing or during a naval engagement created problems of command and control that had been unknown before the introduction of artillery. Three - the most important effect however was on the military personnel, as the successful operation of artillery pieces required maintenance personnel with considerable technical skills. The development of these skills fits into the overall process of professionalization of warfare that can be observed in the Hellenistic period and eventually culminated in the Roman army of the principate, in which a high degree of technical competence as well as literacy was a prerequisite for advancement beyond the lowest ranks.

PENG Wen-Xian | Graduate Institute of History, National Tsing-Hua University, Taiwan, Taiwan

'Centipede ships' (蜈蚣船) and the Chinese shipbuilding tradition

In 1643, a sea battle was waged near the coast of Guangnan Province (present-day Vietnam). At that time, the Dutch VOC (Vereenigde Oost-Indische Compagnie, 1602–1800) was the strongest sea power in Asia and South-East Asia. However, while three Dutch ships stopped near the Guangnan coast, as the sailors aboard began their morning prayers, forty to fifty small local ships were swiftly moving towards them. Since the Dutch ships were armed with powerful cannons and the sailors were accustomed to attacks of far more mighty enemies, the Dutch sailors did not worry much about those small ships that could not cause, they naively believed, any damage to them. Yet the small ships launched an attack against the Dutch, at the end of the battle, one Dutch ship was sunk, and the other two barely escaped. What did those local ships look like? During the Chinese Ming Dynasty (1368-1644) there were at least two kinds of galley-like ships, the pictures of which can be found printed in contemporaneous books. One can find depictions of ships that look like galleys, representing an old Chinese and Southeast Asian shipbuilding tradition. There are additional numerous other pictorial representations of them in a number of books. However, there were also ships that looked very different. These were called "centipede-ships" (wugongchuan 蜈蚣船). These "centipede-ships" were quite different from the galley-like ships that belonged to the Chinese shipbuilding tradition, and I will explain the major differences between these two kinds of ships and advance a new hypothesis concerning the origin of these centipede-ships. My study is based on pictorial representations of these two kinds of ships found in medieval Chinese treatises, as well as on the shipyard records. I have also compared these images with those of contemporaneous ships developed in countries outside of China in order to find out where the design of the "centipede-ships" may have come from.

P120-B. Early modern guns and forts

Wed 24 July, 11:10–12:40 ▪ Schuster Moseley

Chair: Brenda J BUCHANAN | University of Bath, United Kingdom

Michael CHARNEY | Institute for Advanced Studies on Asia, University of Tokyo, Japan

The roles of gunpowder and pre-existing 'military' organization in the status of firearms in seventeenth-century Kandy, Burma, and Japan

There were many factors that help to explain both why and how firearms were retained, augmented, or "abandoned" in different states in early modern Asia. Although the Portuguese played a role in introducing firearms across maritime Asia in the sixteenth century, in the seventeenth century different societies had to make hard choices concerning not just how to use and control the gun, but also whether to retain its use at all. The present paper builds upon the feedback, and additional fieldwork in Japan to address that feedback, to an earlier paper presented at the ICOHTEC Conference in Barcelona in 2012, to consider the role played by gunpowder and gunpowder-making technology. In particular this paper focuses on how gunpowder availability intersected with pre-existing military organisation to influence choices made about firearm technology in the case studies of Kandy, Burma, and Japan in the seventeenth century

Steven A. WALTON | Michigan Technological University, United States

Geometry, method, and the rise of *trace italienne*: fortification in the sixteenth century

The development of fortifications from castle in the early modern period has always been taken as one of geometry above all, for the later *trace italienne* fortifications were above all, polygonal. By comparing late castle-building in the fifteenth century with developed *trace italienne* fortresses in the seventeenth century, such a progression seems uncontested. But such a comparison leaves out the developmental stage in the first half of the sixteenth century where fortification designers and commentators considered what it was to be a defensible place in regard to the newly-powerful gunpowder artillery.

This presentation takes a look at northern European developments from the 1520s to the 1560s in order to investigate how the initial Italian developments began to be integrated into town and fortress wall design, and how authors considered the process and intellectual framework of that development. In particular, I will look at Albrecht Dürer's *Befestigungslehre* (1527), Robert Cornweyle's *Keye of the Tresorie* (1556) and Jacopo Aconcio's *Booke of Fortyfying* (c.1560) to see how northern design tactics evolved in this period. Principally, what I hope to prove is that geometry was foregrounded in the study (Dürer) which was unsuccessful in fundamentally altering the design of military architecture, while the "method" of fortifying specific situations drove the implementation and dissemination of the more successful Italianate (polygonal) system, but did so without much geometry proper.

Juan NAVARRO-LOIDI | Independent scholar, Spain

The selection of cadets of the Royal Artillery in eighteenth-century Spain

In Spain, as in other European kingdoms, military officers learnt their duties mostly following the advice, instructions, and example of senior colleagues until 18th century. To be a nobleman and some experience was enough to become an officer. The qualities expected for the post were assumed to have been acquired by their noble origins.

The situation was slightly different for the artillery. At the beginning, when gunmen were needed the king looked for new gunners among craftsmen such as carpenters, or blacksmiths. Gunmen had some characteristics of a guild with an admission test, a patron saint (Santa Barbara), and ranks with different names of those of the infantry or cavalry. Officers had also to be nobleman in Spanish Royal Artillery, but the rule was not as strict as in others branches of the army.

A growing need for mathematical expertise prompted the appearance of technical academies and a break in the traditional monopoly of nobility during the 18th century. Besides the proof of nobility an admission test

or entrance exam was established in France and other countries for the admission in military academies.

This development was different in Spain. Some military academies were opened during the 17th century. But, the first lasting institution was the Academia de Matemáticas Militares de Barcelona opened around 1720, mostly for military engineering. For artillery the attempts failed until the opening of the Royal Military College of Gentleman Cadets of Artillery in 1764. The admission in that College went in the sense of reinforcing the mobility and not the mathematical formation of the candidates. To be admitted a cadet had to prove the noble birth of all four grandparents with certified documents. It was not established an admission test.

The success of the College of Artillery brought as result a great demand of places. But no entrance exam was created. Instead of an exam, a recommendation, if possible of the king, was of common usage among successful aspirants at the end of the 18th century. The lack of knowledge of the majority of the accepted boys was a problem for teaching in the Royal College of Artillery. However, pupils were very young, from twelve to fifteen years, and the inconvenient was overcome with support courses and accepting school failure to a certain extent.

P120-C. Military technology in the long nineteenth century

Wed 24 July, 14:10–15:40 ▪ Schuster Moseley

Chair: Steven A. WALTON | Michigan Technological University, United States

Christophe BONNET | Université Sorbonne Nouvelle - Paris 3, France

William Wilkinson and the casting of guns for the French navy, 1774-1795

Marchant de la Houlière, a French metallurgist and Royal Army officer, went to Britain in 1774, looking for new processes to refine cast iron using mineral coal. He brought back something else: a business plan, and a business partner.

The plan: to establish an English style gun-foundry, capable of remelting old canons to cast them anew; the partner was William Wilkinson, brother of Ironmaster John Wilkinson, whose works at Broseley had made a formidable impression on Marchant de la Houlière.

The making of cast-iron guns for the Navy was under close supervision by the State. The first challenge was thus to convince the authorities their interest in importing these British processes to France. This paper will examine the strategies that were employed to that end and what resistance they met – for technological, economic or nationalistic reasons.

Wilkinson did actually initiate the building of new works in France: the Indret foundry near Nantes, where cast iron was remelted and cast into guns and, a few years later, new works at Montcenis-Le Creusot, in Brugundy, which were devoted to a full reproduction of the British process, including coke smelting. This extension to the original project raises new questions: what set of technologies were actually being imported, and to what end?

We will then explore the ramifications of these first endeavors into the realm of late XVIIIth-century gunmaking: what part of the British process were indeed incorporated into the French gun-casting industry, and what impact those changes had on that industry.

Janis LANGINS | University of Toronto, Canada

From Vauban to Clausewitz: from military systems to military theories

The great military theorist and philosopher Carl von Clausewitz had contempt for the plethora of manuals on the military art during the Enlightenment and proposed his own science of war that lacked the

rigidity (and often the clarity) of these manuals. The dominant feature of many of these manuals was a search for a “system” that purported to provide the key to victory in war. This concept of system is often associated with the great fortifier Vauban who was declared to be the author of a number of “systems” of fortification. I will suggest that Vauban's reputation and the theories of fortification ascribed to him were influential in inspiring the belief that a rational and teachable art of war based on first principles was possible. The example of the technology of fortification and siegecraft introduced a new approach to writings on war in general the late eighteenth century. It is an example of the influence of things on ideas that were extrapolated beyond their originating locus.

There is irony in this because in spite of Vauban's reputation he was not the man of systems that many of his emulators and disciples thought he was. In part this misconception arose from a reputation that dazzled and blinded and in part because of the success of the military engineering school at Mézières whose courses on fortification added to the prestige of the master. Clausewitz conceded that writings on siege warfare had provided the germ of the science of warfare as he envisioned it but that they also imposed a limit to an intellectual approach that he claimed to overcome in his own work.

Ciro PAOLETTI | Commissione Italiana di Storia Militare, Italy

Showing technology: results from technical tests by the Italian Royal Navy in 1872 and 1877 through an early use of photography

The Italian Armed Forces began using photography before national unity, that is to say at least since Spring 1859 on battlefield, also if there are pictures of Piedmontese men-of-war from the late 1840s.

In 1861, the Royal Navy took pictures as a documental evidence of the progressive building of the new Arsenal and Shipyard in Spezia, from the first diggings till the first time when its dry-docks were flooded, the very moment when the water entered. These was an interesting use of pictures as a document, but was not, or not yet, an use of the photo as a tool, a technical tool, to be shared with an audience as wide as possible in order to transmit experience and factual evidence.

Things changed when in 1872 the Italian Royal Navy began testing torpedoes in Venice. It is unclear who had the idea of exploiting photos to give evidence of the results, but it was done. The pictures of the targets were immediately published, in order to give all the personnel of the Navy an idea of the effects of the tests and, of the effectiveness of the new weapons the Navy was testing at that time.

It was important because it was the first published photography - actually it was a group of four - on an Italian Military journal, and, one of the first in world (the first photograph in France was published by “l'Illustration” only in 1891).

Photography was used a second time with an extensive coverage of the 100tons cannon tests occurred in La Spezia in 1877. The Rivista Marittima, the Navy official journal, published no less than 24 pictures showing in detail the effects of the shots on the targets, with an appropriate comment.

This paper describes how the experiments were made, shows the pictures published at that time and says how they were used in order to provide evidence and disseminate the results of the experiments.

P120-D. From the late nineteenth century to the First World War

Wed 24 July, 16:10–17:40 ▪ Schuster Moseley

Chair: Ciro PAOLETTI | Commissione Italiana di Storia Militare, Italy

Dagmar ELLERBROCK | Max Planck Institute for Human Development, Germany

~~WITHDRAWN: Far behind fashion and desire: the German Reichsrevolver M 79~~

Yoel BERGMAN | Tel Aviv University, Israel

Alfred Nobel's 1889 ballistite tests in France

A series of letters from French officials to Alfred Nobel during 1888-1890 were found recently in Sweden. They provide evidence that ballistite was examined by the French army during 1889. These activities were only guessed before from Paul Vieille's 1893 study and from an article by Patrice Bret. Nobel's first ballistite patent application of late 1887 was not met with enthusiasm by the French government. It preferred its own smokeless poudre B, which it believed was less erosive and less dangerous to manufacture. No details were given in various sources on continued efforts in France, following 1887. His next known step was the signing of a first contract with Italy in 1889. The letters demonstrate that the French rejection was not total. Nobel and his French partner Paul François Barbe (the influential member of the Chamber of Deputies) continued with their efforts to promote ballistite with the army and the private industry. In a late 1888 letter Nobel asked the army for the performance acceptance criteria of the Lebel military rifle, developed in 1886 with poudre B, which greatly increased its muzzle velocity. Ballistite samples were tested following the letter by mid 1889. In what seems to follow, Charles de Freycinet the minister of War sent a letter to Paul Barbe on July 3, 1889. He suggests more optimal thicknesses and lengths for Ballistite flakes and cubical samples which were already tested. De Freycinet writes that he is also ready to test Nobel's powders in larger calibers and provides the needed technical data for a 90 mm cannon. Another official letter of late December 1889 indicates that the minister of War was still interested in providing Nobel with the ability to test his powders. In some of the letters the minister and other officials take care to remind Nobel that, even if his powder is shown to be better, they are not required to accept it.

Larry BURKE | Carnegie-Mellon University, United States

Learning to manage the airplane in the US Army and Navy before the First World War

Getting the United States military to purchase the first airplane (1909 for the Army, 1911 in the Navy) required "technology champions" to convince their organizations that it would be money well spent. But that is only half the problem in introducing a new technology. The military officers who had championed the purchase of the airplane now had to figure out how to manage the new technology so that it could be used effectively and prove to their parent organizations that the airplane really was a worthwhile purchase.

My paper will examine both the men who championed the airplane in each service as well as the organizations they were able to create to manage this new technology. The need to fit into the established military bureaucracy in each service meant that a variety of factors also influenced how those nascent aviation organizations developed in the Army and Navy. How the airplane was managed influenced how the airplane was used (or not used, as the case may be). Factors such as the personalities of senior officers (for whom supervision of aviation was only a small part of their job), service culture, and even basic service missions all influenced how aviation was managed in each service. By comparing and contrasting these elements in the US Army and Navy between 1909 and 1916, I hope to re-open the historical dialogue: Some decisions about the airplane's employment in military service that were taken for granted in one service but were the topic of great discussion in the other service. In this way, I hope my paper will get historians to re-think how all of these factors shaped the development of the airplane in the Army and Navy prior to the First World War, and in turn, reexamine issues that might be taken for granted in the development of new or "best" uses of other new technologies.

Jeffrey LARRABEE | US National Guard Bureau, United States

Fit for duty: mechanical exercise and American medical practice in World War I

Mechanical exercise was legitimized in the American medical profession during World War One after it found direct application as a rehabilitative therapy. Therapeutic mechanical exercise was not a new phenomenon, having its initial manifestations in North America as early as the 1820s, but it tended to be a cure for the wealthy and had little practical application on a wider scale. Twentieth century industrialized warfare effectively democratized the battlefield and patient care through the sheer numbers of combat casualties – and opened the door to therapeutic exercise as accepted medical practice.

Contemporary medical exercise practice will be examined and contrasted by comparing the state of the art John Harvey Kellogg's "Battle Creek" system of therapeutic exercise, the work of Robert Tait McKenzie, a Canadian doctor who became a driving force for the application of mechanical exercise to the rehabilitation of soldiers in North America, and records of the U.S. Army's Surgeon General, which chronicle how American wartime medical practice evolved to place a major emphasis on soldier rehabilitation.

Although mechanical exercise as preventive medicine was still marginalized by the American medical profession, the American medical profession's experience in World War One legitimized mechanical exercise as rehabilitative medical treatment, and emphasis that seems to have spread beyond treating military casualties. The impetus for this acceptance was undoubtedly the large numbers of returning citizen-soldiers requiring continued treatment. This necessity also spurred the U.S. government to provide rehabilitative medical services to veterans on an unprecedented scale, and anticipated the eventual creation of the Veterans Administration. World War One, as the first war in which battlefield casualties exceeded non-battle casualties, demonstrated that therapeutic exercise critical to successfully making soldiers fit once again for duty or civilian pursuits. In modern, industrialized war – or society, began to be as essential in helping repair the human bodies that other machines had helped injure.

P120-E. Between the wars

Thu 25 July, 09:10–10:40 • Schuster Moseley

Chair: Chris VAN SCHAARDENBURGH | Coventry Transport Museum, United Kingdom

Loredana VANNACCI | Commissione Italiana di Storia Militare, Italy

Exploiting the Italian Regia Aeronautica in commercial advertising between the world wars

In 1923 Italian Military Aviation was established as a self-standing armed force, named Regia Aeronautica (Royal Air Force, but in fact, literally, Royal Air Navigation). In a few years, her men got a lot of air-records, and this was exploited. This remarkable quantity of records sounded interesting and appealing. So, commercial companies began using the Air Force as their advertising testimonial. Being it a highly technological Armed Force, they linked their message to the mainly technological aspect, that is to say: the record obtained was linked through the image to the engines, that is to say to technical aspects.

It is hard to say whether this approach succeeded or not. The products belonged usually to two different kinds. There were technical parts, such as parts of engines, and daily-life items, like watches, or drinks. As a matter of facts, this kind of advertising in fact excluded women as potential buyers, due to the kind of offered and showed products, but, on the other side, did not, or could not, attract this so much people, due to the often highly specialized – for that time – kind of goods or tools offered through advertising.

The paper briefly tells this story, describes the kind of companies and their products, focusing on their reduced diffusion among the consumers

and on their lack of appeal, especially on women. Anyway, the Air Force was used as a testimonial of high quality products, whose producers, by the way, survived and, most of them, are still industrially active.

Jeremy KINNEY | National Air and Space Museum, United States

Great Britain and the Schneider Trophy competition, 1924-1931

In September 1927, Flt. Lt. S.N. Webster of the Royal Air Force (RAF) High Speed Flight won the international Schneider Trophy competition in a Supermarine S.5 racer at Venice, Italy, at an average speed of 281.65 mph. It was the first time in history that an airplane designed to land and takeoff on water flew faster than its land-based counterparts. French industrialist and early aviator, Jacques P. Schneider, created the trophy in 1912 to encourage the development of commercial seaplanes. The first contest in April 1913 featured only two aircraft. By 1927, it was the world's most famous air race. More importantly, the Schneider competition became the proving ground for high speed aeronautical technology and a means for military aviation organizations to promote their roles in their national defense establishments. The High Speed Flight went on to win successive competitions in 1929 and 1931 and retire the Schneider Trophy and with it the status of leading the world in aeronautical technology.

The High Speed Flight was part of a joint partnership between industry, government research, and the military. The program resulted from the British reaction to the American victory at the 1923 Schneider Competition. U.S. Navy Lt. David Rittenhouse won flying a Curtiss CR-3 racer that incorporated completely new ideas of streamlining and fuselage design. To keep up, the British embarked upon a military-sponsored high speed aircraft development program that used the Schneider Trophy competition as the laboratory. Participation in the high stakes speed contest taxed the coffers of the Air Ministry and focused on technology that by 1931 would no longer be directly applicable to practical aircraft in the name of aerial nationalism. It also sparked an internal debate within the RAF on the organization's appropriate role in the public eye.

Vasily BORISOV | Russian Academy of Sciences, Russia

Echoes of Nikola Tesla's invention of 'death rays' in the USSR in the 1930s

In July 1934 Nikola Tesla, a prominent Serbian-American inventor, made remarkable claims for invention a principally new weapon. Tesla's statement was published in *New York Times* and in other editions. Tesla described the weapon as an apparatus sending concentrated particle beams through the air. The beams had been called "death rays" (or sometimes "peace rays") by the press. The inventor described the weapon as being able to be used against ground based infantry or for anti-aircraft purposes. Tesla emphasized a tremendous energy of particle beams, thanks to which they could take out up to 10,000 enemy airplanes and an enormous number of soldiers from 250 miles away.

The information about possible appearance of new weapon could not help evoking great interest of the Council of Labour and Defenses and other leaders in the Soviet Republic. After discussing the question with experts it was decided to carry out researches and developments in this field in USSR. The task to investigate the possibility of making mysterious "death rays" was assigned to the Leningrad Electrophysical Institute. In 1935 the Institute received "numbered" title NII-9 and was turned over to the Aircraft Industry.

A new subject of investigation in the Institute became the development of powerful generators of electromagnetic energy in ultrahigh frequency (UHF) range. Some members of the staff considered such devices unpromising for anti-aircraft and similar purposes. So academician A. Chernyshov, director of the Institute, future academicians Yu. Kobzarev, N. Papalexi, and other scientists decided to get their discharge from the Institute.

Subsequent works in the NII-9 showed that electromagnetic radiation in the UHF range could cause engine misfiring only in old wooden aeroplanes. New aircrafts with metal fuselages were practically insensitive to UHF rays. In 1937 ten engineers together with N. Smirnov, director of the NII-9, were arrested. They were imprisoned for two years. Then the results of their work were called for: powerful UHF generators found application in radar equipment, in UHF hardening, etc.

In 1938 the NII-9 together with other institutions developed the radar station with the distance of finding the aircrafts up to 100 km. The authorities forgot about the "death rays", but only for some two decades: to the appearance of the devices of quantum electronics.

P120-F. Second World War military technology

Thu 25 July, 11:10–12:40 ▪ Schuster Moseley

Chair: Margaret VINING | Smithsonian Institution, United States

Chris VAN SCHAARDENBURGH | Coventry Transport Museum, United Kingdom

War effort: the achievements and legacy of the British motor industry during the Second World War

Apart from turning pre-war car production into military vehicle production, the British motor industry significantly contributed to wartime production via the 'Shadow Factory Scheme' whereby the motor industry 'shadowed' other companies in building their products. Motor manufacturers throughout the United Kingdom built large numbers of tanks, aircraft engines, complete aircraft and a variety of other wartime components.

This research study, which is submitted for possible inclusion in ICOHTEC's eighth symposium on the social history of military technology, looks at the achievements and the legacy of the partnership between the government, the motor industry and the labour force during the Second World War.

The research is part of an upcoming exhibition, about the wartime achievements by the British motor industry at Coventry Transport Museum.

Apart from the wartime achievements, I will look at the legacy of the following topics on the post-war motor industry:

- Building of military products/non-motor vehicle components.
- Wartime production techniques/technology/facilities.
- Large un-skilled workforce/large female workforce.

Much of the evidence is archival material from the National Archives, London, archive material held by the main transport museums in the United Kingdom and published primary sources.

Timo VILÉN | University of Tampere, Finland

The development of science-based technology in Finland during the Second World War

Scientific research in the Second World War has attracted the attention of numerous historians. However, while the development of Big Science projects such as atom bomb and radar have been explored in great detail, less attention has been paid to "Little Science", ordinary scientific work conducted in various universities, research centres and laboratories in the course of the war. Little is also known about the mobilisation of science for the purposes of war in smaller countries such as Finland. As suggested by Mark Walker, this uneven coverage is both the result of, and the reason for the tacit assumption that focusing on large-scale projects would reveal the pattern the rest of science followed. Yet when looking at scientists working, say, in Finland during the Second World War, such assumption appears obsolete. Our paper is concerned

with the development of science-based technology in Finland during the Second World War. On the one hand, the War severely hampered scientific research in Finland – simply because the majority of Finnish scientists were being called up to the Front. On the other hand, the war provided new openings for some individual scientists and fields considered relevant for the war effort. An exemplary case is the State Aircraft Factory where a group of able researchers were able to conduct development work in bearable material conditions. Another illustrative case is that of Alvar Wilska, a Finnish physiologist who was able to make valuable contributions to a variety of fields ranging from war surgery to the development of air surveillance. It is perhaps less surprising that the contributions of the Finnish scientists did not result in major scientific breakthroughs, let alone wonder weapons that could have turned the tide of the war for Finland. Rather, the need to overcome the wartime shortages and inconveniences gave rise to minor improvements in weapons and a range of technologies that may be termed “surrogates” – technologies that were vital to the war effort but that could not be purchased or had to be adapted to the local conditions. After the War, the experiences gained in such research laid the foundation for a successful production of civilian goods.

Esat ARSLAN | Çağ University, Turkey

The Ankara wind tunnel and Turkish aeronautical technology

Wind tunnels as of the facilities which provided with observation and test opportunities through full-scale models in the previous time of actual flying time had been an important position in the aeronautical development from the beginning of the 20th Century. The decision to found the Ankara wind tunnel was taken simultaneously with the decision to found the Etimesgut Aircraft Factory in Ankara. After the Etimesgut Aircraft Factory was established, an Aerodynamic Research Center was founded in 1941, during the Second World War, because Turkey had been producing civilian and military airplanes and their engines. After Turkey joined NATO, it stopped building airplane and the earlier production was forgotten. The Ankara Wind Tunnel (AWT) project was undertaken by the Ministry of Turkish National Education in. Construction lasted three years. AWT became operational in 1950. Although the facility was capable of investigating aerodynamic forces and moments, flow characteristics, and other physical phenomena, it remained unused. In 1993 TÜBITAKSAGE began a renovation project that lasted until 1998.

The Ankara Wind Tunnel has a closed circuit, horizontal loop, low speed wind tunnel with a closed atmospheric test section. Test section size is 3.05 m wide, X 2.44 m high, and X 6.10 long. In the test room the flow velocity can reach up to 90 m/s (324 km/h). The full sized object or the scaled model is assembled to the test section. The flow velocity can be supplied up to 324 km/h. The tested object can be positioned to required angle and with the help of internal and external balance systems the load measurement or the flow observation can be carried out with diverse techniques.

P120-G. Weapons of mass destruction

Fri 26 July, 09:10–10:40 ▪ Schuster Moseley

Chair: Jeremy KINNEY | National Air and Space Museum, United States

Wayne COCROFT | English Heritage, United Kingdom

Knowledge at work in Britain’s early atomic weapons research establishments

The United Kingdom was the third country to develop and detonate an atomic bomb. Under the guise of Basic High Explosives Research this was achieved in a remarkably short period of time between January 1947 and October 1952. Knowledge about the design of the atomic

bomb was known to a handful of British scientists who had worked on the American led, wartime Manhattan Project. To translate this know-how recorded in notebooks, or held in the minds of the scientists, to a practical weapon required purpose-built research facilities and novel industrial plant.

In comparison with the growing number of published studies of early United States’ nuclear weapons test and manufacturing sites, the histories of Britain’s early atomic weapons research establishments remain largely unknown. This paper will explore, through the places where these events happened, the development of Britain’s first atomic bomb and the subsequent trials that led to the deployment of *Blue Danube* with the Royal Air Force.

The early years of Britain’s bomb project were characterised by a period of economic austerity, but also an imperative to bring the project to fruition as quickly as possible. Areas of existing government research establishments, such as the Royal Arsenal, Woolwich, and Fort Halstead, Kent, were adapted to the project’s specialised needs and where necessary purpose-built structures were constructed. These were places where scientific concepts were tested and translated into physical components for trials, further refinement, and assembly to create an atomic bomb. The trials also allowed the scientists and technicians to acquire the necessary familiarity to assemble a bomb, to conduct field trials, and to pass this knowledge on to service colleagues who would be responsible for the deployment of the weapon.

Elizabeth TYNAN | James Cook University, Australia

Fallout from nuclear colonialism: British nuclear tests in Australia and their aftermath

The British nuclear bomb test program held in Australia in the 1950s and early 1960s is a tale of nuclear colonialism that had long-lasting fallout in Australia, both physical and political. A large portion of the test program was held in the South Australian desert, mostly at a remote location called Maralinga. The Maralinga tests, especially the plutonium tests known as Vixen B, were conducted under the cover of extreme secrecy. The secrecy put in place at the Maralinga test range, shored up by the imposition of information controls such as D-notices that deliberately fostered media self-censorship, enabled experiments of unprecedented risk to be conducted without public consent and their toxic aftermath to be left unaddressed for many years. The nuclear tests are among the most significant events in Australia’s history not to have been subjected to media scrutiny until many years after they took place. Many of the requirements for secrecy were imposed by the British authorities who conducted the tests. The Australian government under Robert Menzies was found later in the Royal Commission into the tests to have been overly compliant and insufficiently vigilant. Australia was not itself a nuclear power but was hosting extensive atomic tests on its territory, with little effective say in their conduct. The Australian public was largely oblivious to the events at Maralinga while they were underway. A great era of uncovering, driven primarily by journalists, began in the late 1970s and continued until 1993. The entire British nuclear test program was spread over 11 years and took place at three locations: the Monte Bello Islands off the Western Australian coast, and Emu Field and Maralinga in the South Australian desert. A total of 12 major atomic bombs were exploded. The Vixen B radiological experiments were only held at Maralinga and involved exploding the longest-lived isotope of plutonium using conventional explosives. These tests took place in 1960, 1961 and 1963, arguably in defiance of an international moratorium on weapons testing. They received no media coverage at all until the late 1970s. The Maralinga site was extensively contaminated by Vixen B, a problem that was not addressed in any meaningful way until after the publication of a landmark piece of scientific investigative journalism published in 1993. This paper examines the tests, particularly Vixen B, and considers the long-lasting aftermath that is still being felt today.

Glen ASNER | Office of the Secretary of Defense, United States

The decline of the test: the politics of weapons testing in the United States, 1983-2009

The establishment of the Director, Operational Test and Evaluation (DOT&E) as a statutory position reporting directly to the Secretary of Defense in September 1983 represented a hollow victory for both critics of wasteful spending and advocates of effective and reliable weapon systems. Prior to the establishment of DOT&E, a Director, Defense Test and Evaluation oversaw all elements of the testing process: developmental testing prior to initiating full-scale development; initial operational testing prior to full-scale production; and then follow-on operational testing of a system in production. What the new position gained in stature, it lost in scope of responsibility and oversight ability. The most important elements of the weapons testing program, developmental testing and initial operational testing, were moved further down the chain of command.

Developmental testing fared worse in the 1990s, a casualty of reforms aimed at promoting commercial practices and reducing red tape. The end result was the downgrading of test and evaluation capabilities throughout DoD. The Army and Air Force largely ceded responsibility for developmental testing to the contractors who built the weapon systems. The Pentagon's developmental test and evaluation office was dismantled in 1999. Problems abounded in subsequent years, with defense officials reporting in 2007 that half of all programs failed their initial operational test.

This paper explores how a series of well-intended reforms undermined the ability of defense officials to evaluate and exercise control over the weapons programs for which they had ultimate responsibility. It serves as a cautionary tale for policymakers who advocate ceding responsibility for testing to private contractors and limiting government oversight to judging final products. In the worst cases, allowing contractors to conduct their own tests with minimal government involvement resulted in weapons entering production long before development objectives had been met, generating massive cost overruns and leading to the cancellation of a few significant weapon systems. This paper seeks to explain how efficiency efforts of the 1990s set the stage for cost overruns and how ideas about the responsibilities of defense contractors shifted in the face of evidence that the lack of government involvement in testing undermined the weapons development process.

Joseph P. HARAHAAN | US Defense Threat Reduction Agency, United States

WITHDRAWN: Controversies and solutions in Russia's destruction of chemical weapons, 1992–2010

P120-H. Cold War military technology

Fri 26 July, 11:10–12:40 ▪ Schuster Moseley

Chair: Barton C. HACKER | Smithsonian Institution, United States

Petter WULFF | Royal Institute of Technology, Stockholm, Sweden

Security for sale: commercial versus national values in Swedish arms production

Sweden has off and on been at the forefront of military technology development. One example is the development of cannon technology in the 19th and 20th century by the companies Åker and Bofors respectively. The products developed have served the Swedish armed forces but also the armed forces of other countries.

The commercial logic says that the more products you sell the better. From a nationalist perspective this is problematic, as sales of qualified military equipment to potential enemy states tends to nullify the

advantage of having that equipment. It is asked how this dilemma has been addressed by the military authorities of Sweden. Especially the case of exports to Russia will be investigated, as it is where the dilemma is most dramatically illustrated. What arguments have been raised to motivate the export (or non-export) of weapons there, and how much has been exported to this traditional foe?

Thinking of the conference theme, what is "Knowledge at Work" in this context? If we take knowledge to be *knowledge about national security*, we may ask to what extent it has come to influence the *work of arms producers* in marketing and selling their products.

John LAPRISE | Northwestern University, Qatar

Chilling effects: the pervasive influence of Cold War telecommunications security policy

During the last decades of the Cold War, The US and the USSR eschewed direct conflict with its attendant nuclear risks for high stakes technological espionage. In the 1970's, the White House began to craft policy to counter Soviet interception of domestic telecommunications in secret. Over the course of the next twenty years until the fall of the Berlin Wall, the US Government cooperated with its industrial partners to protect US telecommunications networks. The US government built security into US telecommunications networks in even as it was deregulating the US domestic market. Following 9/11, US counterterrorism efforts focused on intelligence and information security. The White House called upon the dual use technologies and policies developed for use against the USSR and appropriated them for use against Al Qaida and other terrorist organizations, in some cases by the selfsame actors. The results are decidedly mixed with both dramatic successes and failures. At the same time, the public has become alarmed by some of the surveillance aspects of these technologies. This research draws attention to the distinct continuity of US telecommunications security policy irrespective of the the threat and questions the applicability of methods and technologies developed for use against a superpower to the threat posed by loose networks.

Layne KARAFANTIS | Johns Hopkins University, United States

Spaces of control: exploring the design of command centers

Tiered rows of workstations all face a large wall, much like a movie theater. Men—the space is conspicuously absent of women—look to the various screens on the wall for information while communicating via headsets and crunching numbers on ancient computing devices. They are coordinating a highly technological mission. This scene describes any number of American Cold War command centers, such as NASA's Mission Control, the US Air Force's Strategic Air Command, or the North American Aerospace Defense Command. I explore the design of spaces of control such as these, asking how these massive central sites coexisted with civil defense strategies such as dispersal, and what these hubs can teach us about the effects of capitalism, efficiency, and bureaucracy in postwar America. I also question why the composition of these centers has persisted into the present. Certainly, knowledge is at work in these stations, both between the commanders and the recipients of their orders, as well as how the spaces were designed with power schemes in mind.

P121. Men, knowledge and technologies in the development of the modern oil industry up to the early decades of the twentieth century

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Wed 24 July, 14:10–15:40 ▪ Schuster Bragg

Symposium organiser: Francesco GERALI | NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO, Mexico

Symposium abstract

This proposal was born from the remark that oil historians rarely have the opportunity to present their works in thematic sessions hosted in international symposia. At the end of the XIX century the oil industry was like a Leviathan, a powerful system managed by companies that in few years acquired the status of the world's biggest multinational corporations. Despite of this, Petroleum Geologist, Engineer and Chemist were categories still unknown in universities and oil companies. Among oil technologists of the first years of XX century a specific association aimed at promoting an international dialogue did not exist. A century later, even petroleum historians lack a global group for discussion of their interests.

Internationality is an element that characterized modern oil industry since it took its first steps in the middle of XIX century. The mobility of technologists and technologies, the international economic interests of mining many companies, the worldwide demand of refined oil, are all components that contributed to the rapid expansion of the oil sector. Started as a craft mining activity with few means and workers, the oil industry between the thirties and the sixties of 19th century benefited from the contribution of scientist and technologist from several countries. Know-how, competence, and the development of new artifacts changed the old petroleum sector into a complex production system in which geology, engineering, chemistry, and logistics began to work in symbiosis. The starting point of this new way of working in the oil industry was Pennsylvania, USA; this experience represented a model for all the countries in which were active oil operations. To understand the meaning of the technological development in oil, it's necessary analyze the national oil case of big producers, small producers and consumer countries. Cross the boundaries of national's oil industry history studies through international dialogue means opening a current of comparative investigations that can allow oil historians to continue the line of research marked by one of the founders of the discipline, the Dutch oil technologist R. J. Forbes.

Chair: James C. WILLIAMS | ICOHTEC / Stetson University, United States

Tatiana IVANOVA | Lomonosov Moscow State University, Russia

The creation of the petroleum industry in Russia: the Apsheron peninsula in the nineteenth century

Data on oil production within the Apsheron peninsula is known from the VII century. In the VI century pit method was widely used. In 1723 by the order of Peter the Great a ton of "white oil" was delivered from Baku to Moscow to be used by the Major Moscow pharmacy for preparing balms. In 1837 by project of mining engineer N.I.Voskobojnikov the first oil recovery factory in the Caucasus (Balkhany) was constructed. Kerosene was obtained using new technologies. Later businessman V.A.Kokorev built the second factory in the Surukhan which production became competitor to American kerosene. In 1871 the first drilling machine for percussion-rod drilling was assembled and began to work. In two years first well gave first oil. From 1876 Baku turns into the largest industrial region with the help of famous entrepreneurs Nobel brothers, Robert and Ludwig. By initiative of Ludwig Nobel first Russian oil-producing company "Comradeship of oil-producing of Nobel brothers". The company drilled 500 wells for 25 years, obtained more than 20 mln ton of oil with the quantity of employees more than 12000 people. Almost 90%

of the obtained Russian oil was delivered from 2 giant fields – Bibi-Eibat and Balkhany – Sabunchi-Ramany. The founder of the company Ludwig Nobel attracted talented scientists, engineers, researchers into his business. Famous Russian scientist – chemist D.I.Mendeleev was initiator of diversified usage of oil as a chemical material, not only as fuel. Engineer-constructor V.G.Shukhov made calculations and was in charge of the first Russian oil pipeline construction; he was the first to propose the new type of oil processing – cracking. Under his guidance first steel oil barge was projected and constructed, first riveted steel reservoirs for oil storage were built. He was the author of a witty decision of active pipelines throughout increasing. Ludwig Nobel – outstanding manufacturer, inventor and founder of civil socially oriented business in Russia – died 31st of March, 1888, in Cannes. He was 57 from which 46 years he lived in Russia. In honor of L.I.Nobel Russian technical society created a grand meeting on March 31st, 1889. At this meeting government of "Comradeship of petroleum production of Nobel brothers" establishes the gold medal and prize by the name of Ludwig Nobel.

This presentation is based on work co-authored by Elena Poludetkina.

Elena HELEREA | Transilvania University of Brasov, Romania
Liviu-Alexandru SOFONEA | Transilvania University of Brasov, Romania

On the history of Romanian oil

Appreciated by the economists, criticized by sociologists, in the name of physical and moral protection of environment, the oil, also called „the black gold” for its qualities, has dominated the economies and the civilization of the world until nowadays.

Formed under the earth's crust or on the bottom of the seas, it has mobilized so many energies for centuries and revolutionized the techniques of processing and transport, constituting a remarkable wealth of many states and finally winning the competition with coal.

In Romania, the exploitation of oil has a long history. The first attestation dates from the second century and it's mentioned in the archaeological discoveries in Sucidava, Tomis, Histria and Targisorul Vechi, continuing during the following centuries. Until the second half of the XIX-th century, the use of oil was restricted to lubricate the wheels of the wagons, to empirical treatment of the animals' diseases and sometimes even for human illness. The writings of the scholar Dimitrie Cantemir and of the prince Alexandru Sutu give proof of that.

The development of product progresses slowly until 1857, when a boom of oil exploitation was held in Romania.

In the paper the premises of the oil technology and extraction industry development in Romania are analysed, and the changes produced at the beginning of the 20-th century, when Romania's oil production registers spectacular increase comparing to the memorable year 1857, so that in the year 1900, the volume of the extracted crude oil represent 1,22 % of the world production. First professional schools are developed and the socio-cultural life was strongly changed.

Authors analyse also the period of industrialization in Romania, with a great impact on oil extraction took place.

Francesco GERALI | NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO, Mexico

Notes on the Mexican oil industry in the nineteenth century

The oil production in Europe and North America during the first half of the nineteenth century was run by a proto industrial system that was inhibited by a lack of mechanization and limited outcomes and was ultimately penalized by the lack of a target market.

During the 1860's the petroleum sector were introduced new practices and production techniques, result of a cumulative process of experience and innovations that started to develop since the first decade of the century. From this path arose a new complex system in which oil research, drilling, refining and logistic taken over new value and

meaning. Pennsylvania was the cradle of the conjunction between processes and physical artifacts: the satisfactory outcomes of this model have gradually influenced, as a domino effect, all the countries in which were active oil operations. Mexico was one of those countries. What represented oil for Mexico? Which influence has had the *Pennsylvanian Revolution* in Mexico? This presentation aims to answer to these questions discussing selected episodes that marked the Mexican oil system during the 19th century. This analysis intends to highlight also the connections and the interdependencies that were been between the Mexican case and the oil system of other countries.

Drielli PEYERL | Universidade Estadual de Campinas, Brazil

Oil professionals training in Brazil: the role of Petrobras in the formation of a national class of geoscientists

From the creation of the School of Ouro Preto in 1875 is that the teaching of geosciences in the country begins to be practiced systematically. Although formally titled as mining engineers, many in fact acted as geologists before the existence of a specific course of Geology. However, only in 1950, with industrialization started in the Vargas government, especially with the creation of Petrobras (1953), is that the training of geologists has become a matter of state and need. Petrobras started its activities from the collection received from the former National Petroleum Council (Conselho Nacional do Petróleo – CNP - 1938), aiming to perform tasks in the field of oil exploration in Brazil. Yet, some characteristics of CNP remained in the company, particularly in relation to political pressure and nationalist who sought to consolidate Brazil as a country rich in oil. A major problem was the lack of qualified personnel for the demands of technical and geological knowledge about the Brazilian territory. Thus, Petrobras has invested in developing courses and technical expertise of professionals in the area. Besides Petrobras, other scientific societies of that period, and agreements with universities, contributed to the formation and constitution of Geosciences in Brazil in another level of institutionalization and professionalization. This project aims to investigate and understand the role of Petrobras in the construction and training courses in Geosciences, as part of the process of mapping the territory, and deepening of other areas of Geosciences which contributed to the studies and research related to work developed by Petrobras. The main source of this research focuses on two collections: the personal files of paleontologists Frederico Waldemar Lange (1911-1988) and Roberto Ferreira Daemon (1936-1996) available for inspection at the State University of Ponta Grossa (UEPG).

This presentation is based on work co-authored by Silvia Fernanda de Mendonça Figueirôa.

P123. The invisible bicycle: new insights into bicycle history

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Tue 23 July, 11:10–Wed 24 July, 12:40 ▪ Schuster Bragg

Symposium organisers:

Tiina MÄNNISTÖ-FUNK | University of Turku, Finland

Timo MYLLYNTAUS | University of Turku, Finland

Symposium abstract

For more than two decades now, bicycle history has been an active field within the history of technology, containing a diversity of studies, from detailed accounts of technological development, to social histories of

cycling, and to theoretical approaches to bicycle use and innovation. Recently, the bicycle has also been attracting increased attention as a sustainable means of transport, the historiography of which is of interest in current debates on mobility.

Despite the ongoing interest and the multitude of historical insights, bicycle history calls for further research, especially since the bicycle has likely been an integral part of everyday life and mobility in all corners of the world at some point in time. Many aspects of bicycle use and technology remain invisible or have only a fleeting presence in bicycle historiography. This is partially due to locations that seem (historically?) peripheral, such as developing countries and rural areas. But even the history of Western, urban cycling asks for more scrutiny, especially during the decades of the bicycle's most intensive use as a means of transport: from the early twentieth century to the 1960s. Similarly interesting are the dynamics of cycling's decline and subsequent resurrection in the second half of the twentieth century.

How can we study the history of everyday practices in bicycle use and non-use? Is the decline of cycling in industrial societies a universal phenomenon? What do the transnational timelines of bicycle history look like? How have technological features and design influenced the image and popularity of cycling? Are there "national styles" in the design and technical characteristics of bicycles? This session concentrates on many aspects of bicycle history, all of them so far understudied. It questions typical timelines of bicycle history and presents alternative histories and controversial case studies. We will study and compare cycling histories in Asia, America, and Europe, scrutinizing the patterns of growth and decline in cycling; examining the actions and opinions of different actors at the individual, local, national, and transnational levels; and looking at the dialogue around the material and immaterial components of the appropriation and use of the bicycle.

P123-A. Patterns of growth and decline

Tue 23 July, 11:10–12:40 ▪ Schuster Bragg

Chair: Timo MYLLYNTAUS | University of Turku, Finland

Peter Cox | University of Chester, United Kingdom

Rethinking bicycle histories

Bicycle history and historiography are currently undergoing significant reassessment. Historical studies on bicycles and bicycle mobility have been dominated by the legacy of chronologically organized accounts of the bicycle as artifact. While valuable, this approach has had a tendency to elide significant differences between specific histories of the place of the bicycle as a component of broader mobility systems in varying geographical locations. New areas of social and cultural history are combining with colonial and post-colonial analyses to understand both the Eurocentric nature of dominant accounts and the hidden possibilities of multiple and plural narratives. Moving away from an artifactual bicycle history, this study embraces recent developments in the study of technology and draws on use-pattern approaches to the study of bicycle technology. Shifting focus to a use-centered account and comparing experiences across geographical boundaries reveals substantial differences in patterns and timescales of the adoption of the bicycle as basis for mass mobility. By taking a comparative approach to the historical and developmental patterns of bicycle use across varying geographies, it becomes possible to isolate the significant factors that may be responsible for shaping cycle use. A comparative use-centered history, placing the bicycle in the context of broader mobility and energy use patterns, can enable better understanding of the social forces at work to shape constraints and opportunities, and provides the capacity to interpret the factors at work in the rise and fall of cycle use. The paper re-examines patterns of growth and decline of cycle use for transport in a number of locations (including the UK, USA, Japan, Switzerland, Denmark, Germany, the Netherlands, and China), in order to elucidate

the factors that have surrounded important change in cycle use. To briefly summarize the main argument of the paper, the roles and influences of a number of actors in times of modal shift are examined. In particular, consideration is given to the contrasting roles of industry and national economic production regimes; users and non-user groups, with specific reference to the role of symbolic value in respect to cycle use; public policy frameworks; infrastructural provision; and finally, attention is paid to the relationship between cycle use and the use of other mobility modes. In conclusion, it suggests new ways in which to think about bicycle history, moving away from the dominant periodized model and pointing instead towards mechanisms of change in bicycle usage.

Anne-Katrin EBERT | Technisches Museum Wien, Austria

Narrating 'decline' in the history of technology: the bicycle's fate in Europe, from 'golden age' through 'decline' to 'renaissance', reconsidered

Over the past decades, historical research on the history of the bicycle has experienced a significant upswing. New questions and methods have extended the previous focus on the development of different technical stages of the bicycle; next to the bicycle itself, users and practices, as well politics and discourse are now taken into account. The long-time dominant focus on the end of the nineteenth century has been supplemented by a reassessment of the entire twentieth century. A new master narrative can be found—either implicitly or explicitly—in many historical accounts of bicycling in Europe: the history of cycling starts off with a period of steady growth up until the 1950s, followed by a period of decline, which lasted until the 1970s, before the "renaissance" of the bicycle started. This classification is based primarily on quantitative material on the use of bicycle in various European countries and analyses of traffic planning and road constructions in the post-World War II period. An older narrative, which hardly plays a role in the current debate, attested the "decline" of the bicycle in the 1950s to the lack of technical innovation. So far, the waning interest of the users in the bicycle has thus been analyzed mainly in an indirect way. If we take a closer look at the bicycle users, the awareness of a "decline" of cycling set in much earlier. In Germany, leading officials of the cyclists' association pronounced a crisis of cycling as early as the 1920s, even though the number of cyclists still increased further in that period. Numbers, discourses, and practices were not always congruent. This paper will re-examine the "decline of cycling" in Europe in the 1950s and ask the question of how we, as historians, deal with historical phenomena such as the "rise" and "decline" of technical artifacts. What criteria do we apply in order to note the beginning and end of a decline? Which factors and what actors, practices, and discourses must be taken into account in order to assess rise and decline? And how useful is our current time-division into a "Golden Age" of the bicycle in Europe up until the 1950s, a "decline" from the 1950s onwards and a "renaissance," starting in the 1970s? Arguably, we as historians situate ourselves in the middle of that "renaissance" and "reappraisal" of the bicycle. What does this master narrative imply for our understanding of the history of bicycle use in Europe, especially in light of the current debates about "green cities" and "sustainable transport"?

Anna-Maria RAUTIO | Swedish University of Agricultural Sciences, Sweden

The development of a Swedish bike trail network in the early twentieth century

During early twentieth century inland northern Sweden was still very sparsely populated and sufficient communications were lacking. Many settlements, which were scattered over the forest landscape, could only be reached by simple foot-paths. The few public roads followed the great rivers and connected inland areas to the coast. However, many villages remained isolated from one another due to poor communication. As a consequence winter was the only time that heavy goods could be transported and the time when all logging activities took place. With time the Swedish forestry required better communications in the forests also

during summer-time, to effectively manage the forest areas that had already been logged. The Swedish Government realized the need of a developed infrastructure in order to prevent people from the two northernmost counties of Norrbotten and Västerbotten of moving to the more developed regions by the coast. The answer to these concerns seemed to be construction of so called bike trails. These trails were only about a meter wide, but stable enough to allow for traffic by bicycles. In this talk I will discuss the factors leading to this development, the extent of the bike trail network and the factors that led to its termination by presenting the history of a few cases of bike trail construction both from field inventories, archival sources and interviews with people that came into contact with these trails.

Commentary: James C. WILLIAMS | ICOHTEC / Stetson University, United States

P123-B. Adoption, appropriation, demonstration

Wed 24 July, 09:10–10:40 ▪ Schuster Bragg

Chair: Nicholas ODDY | Glasgow School of Art, United Kingdom

M. William STEELE | International Christian University, Japan

Betting on the wheel: the bicycle and Japan's post-war recovery, 1945-1958

Bicycle riders in Japan had achieved "invisible," or ubiquitous, status by the 1920s. In 1927, the government declared November 11 to be "Bicycle Commemoration Day," noting that Japan had become "the foremost bicycle riding country in the world." By 1940, there were some eight million bicycles in use. But the war years exacted a heavy toll. After Japan's defeat in 1945, some three million bicycles had been lost and the remaining vehicles were in poor shape. As in other areas of the Japanese economy and society, Japan's postwar bicycle recovery was rapid and sustained. Miyata, Dai Nippon Jitensha, Okamoto Jitensha, and other pre-war bicycle giants were joined by an explosion of small bicycle workshops and factories eager to produce bicycles for peacetime Japan, but it was not until the end of the Occupation in 1952 that production exceeded one million. In 1955, a government white paper declared an end, economically at least, to the postwar period. One year later, in 1956, bicycle production finally topped the 1940 figure by 1.3 million. Increased production allowed more people to realize the dream of bicycle ownership. By 1950, the bicycle census stood at ten million, jumping to 14 million in 1955, nearly double the prewar peak of eight million. By 1958, the figure stood at 17 million, overwhelming the bicycle tax and registration system that had begun in the 1890s. Bicycle use continued to rise, despite rapid motorization. Currently the bicycle census stands at just under 90 million (out of a population of 125 million). This paper will examine the rebirth of the Japanese bicycle industry in the immediate postwar period and seek to explain why the bicycle has remained the "speedy feet of the nation" to the present day. The paper will focus on the role played by promotional subsidies that were derived from profits from legalized betting at bicycle races called keirin, a track cycling event that originated in Japan in 1948. Between 1949 and 1978, the bicycle industry received subsidies amounting to a total of 38,000 million yen, primarily for research and development to improve production techniques and the promotion of bicycle exports. Indispensable to the development of the bicycle industry and the cultural popularity of bicycling, there has been little academic study, in Japanese or in English, on the history of keirin and its connection with the postwar recovery of Japan, as one of the world's foremost bicycle countries.

Sue-Yen TJONG | Eindhoven University of Technology, Netherlands

The shaping of a Dutch national icon: knowledge, mediation and innovations in Dutch bicycle businesses, 1870-1940

The questions of where the bicycle came from and who invented it have been debated since the late nineteenth century. Even nowadays, bicycle historians are debating the early days of two wheeled wooden vehicles. The bicycle was definitely not invented in the Netherlands. So how did the Netherlands become the leading cycling country? With the bicycle's prominent role in mobility, the Netherlands is an exception among industrialized countries, which many attribute to the obvious relationship between the country's utility cycling, flat landscape, and dense population. Even so, the Netherlands' leadership is remarkable, especially when reflecting on the early history of the bicycle as a sports vehicle, first in France, then further improved in Great Britain and the United States. This article analyzes the process of innovation and knowledge circulation that resulted in the mass production of the Dutch bicycle. It unravels the role of Dutch industry in the transformation of the bicycle from a sports vehicle of the elite to a utilitarian good for all classes. In the late nineteenth century the Dutch bicycle industry depended heavily on external knowledge and technology, mainly acquired from Great Britain. Thereafter, a characteristic Dutch product slowly came about, even though the industry continued looking to Great Britain for inspiration. The article illustrates how innovation in small- and medium-sized enterprises played an important role in the adoption of the bicycle in the Netherlands. It analyzes the roles of intermediary organizations in the production and circulation of knowledge for innovation, and reveals how industries turned the bicycle into an icon of Dutch mobility culture.

Kah CHAN | Victoria University of Wellington, New Zealand

The effect of point-of-view cameras on cycle commuting

An escalation of environmental concerns, rising petrol prices, and increasing health concerns has led to a re-emergence of cycling as a viable transport alternative. The impact of this resurgence led to friction in communities that have a less established cycling culture. Lightweight point-of-view (POV) cameras that are helmet or bicycle-mounted are now becoming the "documenters" of these moments of friction, providing an impartial view of the circumstances where cyclists are negatively interacting with other road users. This paper will discuss the use of digital technology in contemporary cycling, focusing on the effects of small, lightweight POV cameras used by cycle commuters. Recent technological advances resulting in smaller and more affordable video cameras means that it is now very simple to share the cyclist's point of view. This provides a unique simulation of the cycling experience, allowing for some insight into the phenomenology of travelling by bicycle. The addition of the ability to share these experiences online heralds a new chapter in cycling history: how has the use of digital media, both hardware and networks, affected the cyclists' experience? Prior to the adoption of POV cameras, negative driver/cyclist incidents were so prevalent that the SMIDSY acronym was coined: "Sorry Mate, I didn't See You". This paper will examine the transition in circumstances that fostered the increased need for cycle commuters to adopt cameras as a defensive mechanism by discussing three parallel developments: the re-establishment of cycling as transportation, the progress in camera technology, and the online networks that support the sharing of experiences. This paper will then consider how these factors combined to encourage the increased use of POV cameras and the extended social effects on the relationships between drivers, cyclists, and pedestrians on the road. The consequences of these driver/cyclist collisions undoubtedly put the cyclist at a severe disadvantage. As these devices become more affordable, we are seeing them used in wider contexts. The most popular utility of these cameras are for commuters to share videos of other road users' errors. The social effects of ubiquitous media devices that capture and share our cycling experiences are divisive; these shared videos are provocative and garner very strong

opinions on all sides. These shifting patterns—evolving road user composition, the corresponding shift in driver and cyclist mentalities, and the emergence of affordable digital media devices—mark a wider period of change in the social behavior of road users.

Kara Hammond LARRABEE | Independent scholar, United States

Gender difference in bicycle design: anatomical necessity or cultural accommodation?

Prior to the "safety bicycle", bicycles were not gender specific because the rider was always presumed to be male. Ladies who pursued this sort of exercise used the expensive tricycle, which allowed for their copious, restrictive garments. The advent of the more balanced and stable diamond frame allowed for the development of a variety of new designs, including the "drop-frame safety", with a sloping top tube, directed specifically toward a female market. The development of the step-through frame changed the relationship women were to have with cycling, making it so popular that Susan B. Anthony credits it with single-handedly advancing women's liberation more than any other thing. The notion of designing a bicycle for women has been primarily about preserving the decorum and accommodating the clothing of women. There is reference, in Garratt's *Modern Safety Bicycle*, to the "graceful undulations" of curving down tubes being more aesthetically pleasing, and therefore more marketable to women, if structurally suspect. The step-through, or "women's", frame still does what it was originally intended to do by being skirt-friendly, and maintains certain advantages for people with less flexibility who do not wish to swing a leg high over the top tube. It remains a popular design today. By focusing on trade catalogues, literature, and periodicals such as "The Bicycling World", Spaulding's *Official Bicycle Guide*, and *The Modern Safety Bicycle*, and others of the late 19th century (which may be found in the collection of the Smithsonian Museum of American History), I will contrast this information with current magazines and literature on performance cycling such as "Velonews" and "Bicycling Magazine". Looking at performance road bikes of today, regardless of gender, the basic diamond frame is remarkably similar to that devised over one hundred years ago, yet there remains a popular perception that women need a different kind of bicycle from men. With the exception of the contact points of seats and handlebars, there has been no anatomical reason to design bicycles differently for women. I would argue that this perception has more to do with historical precedent, fashion restriction, or gender bias marketing than anatomical need. Were each individual's needs better taken into account, we'd see far more men on step-through frames, although probably not in pink.

P123-C. Cycling down by the memory lane

Wed 24 July, 11:10–12:40 ▪ Schuster Bragg

Chair: Anne-Katrin EBERT | Technisches Museum Wien, Austria

Nicholas ODDY | Glasgow School of Art, United Kingdom

A rather tweedy history

In 2009 a cycle ride was set up in London through online forums that has now become one of the socio-cultural highlights of the increased interest in cycling; Tweed Runs are now held internationally. Traditionally, organized cycle rides have been the preserve of cycle clubs. But, with the recent rise of mass charity rides and cycle campaigning, they have become far more public. What makes this one different is that, in a period of retro, vintage, and the Internet, it is a public event staged round the visual evocation of history. The Tweed Run could be seen as the cycling manifestation of many of the values expressed in *The Chap* magazine: a post-modern bricolage of clothing and fashion from the first half of the twentieth century. From a perspective of cycling history, the

Tweed Run is challenging; not only does it focus attention on largely-ignored forms of cycling, mainly those surrounding the “roadster,” or the stereotypical “black bicycle”, (upright machines built on 28 inch wheels during the period c1900-1960), but it also, in particular, associates itself with bourgeois cycle culture. The event is laced with ironic humor that makes it difficult to assess its position in either cycling culture or cycling history. However, it could be argued that a precedent for it exists; that is, the Tweed Run seems to represent a popular understanding of an earlier cycling culture similar to that of the “ordinary” bicycle some two generations earlier. It was the scepticism of this understanding that largely underpinned the development of revisionist approaches to cycling history. Both Herlihy and Oddy have considered the anonymity of early twentieth-century cyclists in the context of a history that has traditionally focused on technological change—the former in the USA, the latter in the UK— The period deserves much more attention, but it seems that academic cycling history is fated to lag behind the visually attractive take on the past that events like the Tweed Run offer. This paper considers the relationship between popular and academic approaches to cycling history as a driver of revisionism. It puts forward a proposal that, as arguably the longest established of all design histories of modern technological consumer durables, cycling history depends on a cycle of myth and debunking.

Kjetil FALLAN | University of Oslo, Norway

Kombi-nation: mini-bicycles as moving memories

Taking a closer look at a characteristic mini bicycle, the DBS Kombi, this paper seeks to explore the multifarious ways this iconic artifact affords material memories. Manufactured by the Norwegian company Jonas Øglænd A/S from 1967 to 1987, it has been a paradigmatic feature of the personal and social recollections of generations of Norwegians—including the author. Spurred by the considerable interest expressed recently in the Kombi bicycle as a vintage item, this study reflects on the role of material artifacts in mediating memories. Viewed against a backdrop of a broader trend often described as retro, or “the culture of revival,” personal engagement on the part of historians with objects such as the Kombi bicycle may help to shed light on the inner workings of vintage culture and the notion of nostalgia in contemporary society. The DBS Kombi emerged as an appropriation by way of redesign of the more famous British mini bike, the Moulton. Øglænd manufactured the Moulton under license from 1965, but, as this was a very expensive model (due mostly to its characteristic feature of both front and rear suspension), the Norwegian manufacturer’s designers soon came up with their own interpretation of the small-wheeled, one-size-fits-all bicycle. More than providing a history of the DBS Kombi, though, this paper offers a personal account of this mini bicycle as a mediator of material memories and explores the role of emotional engagement with non-new objects of use in contemporary design culture. It was on a DBS Kombi that a girl next door, four years my senior, taught me the magic of riding one spring day in 1980; and it was with this bike my father taught me the basics of bicycle maintenance. I am currently the owner of three such bikes (plus a DBS Moulton), purchased, obviously, more for their emotional, nostalgic, and memory-conveying properties than for their utilitarian ones. Restoring and re-possessing them has made me reflect on these objects as “memory machines,” and this paper is a recording of these reflections.

Tiina MÄNNISTÖ-FUNK | University of Turku, Finland

Gravel roads, ripped skirts and shining steel: material memories of cycling in Finland, 1900-1939

In rural Finland, the bicycle was an important means of transportation in the first half of the twentieth century. The number of bicycle owners grew steadily, and in the 1930s cyclists became, in many places, the most numerous participants in road traffic. Bicycles offered the only alternative to walking for many people, but remained also a possession of high status, as their prices were relatively high, even in the 1920s and 1930s.

This paper studies the material reality of cycling in Finland from 1900 to 1939, as remembered in a folklore survey conducted in 1971. Altogether, 656 Finns submitted their personal memories about bicycle and cycling. These written accounts often contain very concrete memories of bicycle trips, accidents, maintenance, purchases, and cycling practices. Through them we can grasp something that is often difficult for a historian to study: the dialogue between people and their material world. Questions that the paper will examine include: How did the very materiality of the bicycle and other material objects used while cycling, such as clothing, affect bicycle use and the appropriation of bicycle? How did they, along with the built and natural environments, influence the mobility of rural people? What kinds of material practices, other than cycling, were connected to the bicycle? What was the bodily experience of cycling like, and what influenced it?

P124. Generating knowledge in practice: experiments in the building sector

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Sat 27 July, 14:10–15:40 • Schuster Moseley

Symposium organiser: **Knut STEGMANN** | ETH Zurich, Switzerland

Symposium abstract

The discourse in the history of science, which occurred in the last 30 years, has revealed the “classical” definition of an experiment as a method of hypothesis or theory verifying inadequate to describe its actual role in the forming of knowledge. Hagner and Rheinberger characterized the shift in understanding as “the change from theory-first views to what could be called the primacy-of-practice view on science”. Knorr Cetina mentions, that whereas the traditional concepts of the knowledge society define knowledge as a scientific content, the modern approach should focus on the mechanisms of practicing, gaining and sharing knowledge within the defined social or professional environment. The “experiment” in this context implies not a definite testing action, but rather a flexible system of interdependent actors, objects and instruments. This extended definition seems to be especially relevant for praxis-related disciplines, as the one of building.

The symposium aims to discuss the nature of experiments in the construction sector applying the extended definition of the history of science. (Explicit) building knowledge grew rapidly in the second half of the 19th century. The role of experiments within this process has rarely and mostly unsatisfactory been analysed. The proposed section discusses the types of experiments in a broad focus, covering the field of building from the newly established materials and novel structural types to the construction sites themselves and within the context of technological, industrial and social development. The paper of Ekaterina Nozhova analyses the development stages of a new structural type and the experiment as investigative research strategy. The paper of Knut Stegmann describes the experiments with concrete in the context of industry and education and analyses the popularization of new knowledge. The paper of Christoph Rauhut focuses on the construction site of the nineteenth century as a changing space for experiments, mirroring different kinds of knowledge exchange.

Chair: **Torsten MEYER** | ETH Zurich, Switzerland

Ekaterina NOZHOVA | ETH Zurich, Switzerland

Schuchov's lattice networks: experimental prototypes and the emergence of lightweight construction

The vast range of works by the Russian engineer Vladimir Schuchov (1853–1939), a Chief Engineer of the Company of Alexander Bary, includes patented inventions in steam boiler design, petroleum engineering, shipbuilding and metal structures. Schuchov's contribution to structural design was embodied in the sequential development of the light construction principles, he is reputed as an inventor of a new structural type – the spatial lattice network. To trace the development of a novel engineering idea from the concept level to the advertised know-how and to analyze the forms of knowledge outcome is a challenge of the paper. It is done with a précised attention to the realities of the Russian Industrial development at the end of the nineteenth century.

In 1897 Schuchov published the work *Optimal Truss*, where he analyzed the weight limits of the truss system and proved the feasibility of a new construction type. The characteristic feature of the new structural principle, offered by Schuchov, was the absence of any type of roof-truss or girder, which were substituted for a lattice network of angle or Z-profiles for arch roofs and for flat bars for suspension roofs. In order to test the structural behavior and assembly methods for the novel structures, experimental real-size prototypes were erected at the Steam-Boiler Factory of Alexander Bary in Moscow, which served as means to verify Schuchov's principles in a practical application. In 1896 the structures were represented to the public at the All-Russian exhibition in Nizhny-Novgorod: Alexander Bary built it on his own means to promote the inventions of Schuchov at the most meaningful public event of the Russian Empire. Thus, the *Optimal Truss*, published one year after the Exhibition and premised by the long preparatory and research process, referred as to the analytical, so to the experimental facts and addressed to examples, familiar to the wide audience.

In summary, the paper reveals the consequent development of a new structural type, which included the collection and analysis of engineering data and the construction of real-size prototypes. At the same time it researches the spread of knowledge, like the presentation at the exhibition and the publication of the engineering pamphlet. The parallel presentation of the technological and market realities illustrates whether the Russian construction industry was mature enough to encourage the undertaken experiments.

Knut STEGMANN | ETH Zurich, Switzerland

Experimental cultures in early concrete construction

In 1928 Sigfried Giedion characterised concrete as a "laboratory product". In fact, the countless experiments with concrete provided an important basis for the processes of creating and distributing knowledge in the field in the 19th and early 20th century. The experimental practice though was very heterogeneous: from single trials to systematic series of experiments. The protagonists were as heterogeneous as the experiments carried out. They ranged from often empirically working, early concrete pioneers, over engineers with university degrees to the materials testing laboratories established at many polytechnic schools in the 19th century.

The proposed paper analyses the development of experimental cultures in concrete construction in a broader focus and, in particular, looks at the actors involved, their backgrounds and strategies. The central thesis is that until the early 20th century concrete pioneers and their companies gave the main impetus for the experiments. Moreover, the impetus from the building practice was an important basis for the later scientification of the field. There are different phases in the development of experimental cultures: Firstly, concrete pioneers carried out experiments on their own. Hereby they laid the basis in terms of material sciences and explored new areas of application for concrete especially in the field of engineering construction. Secondly, concrete companies carried out spectacular public experiments and published the results extensively to

persuade customers of their building technique. In short: experiments became important arguments in advertising. To evoke a more "neutral", scientific appearance of the experiments the companies awarded contracts for testings to materials testing laboratories. However, the lack of theoretical superstructure compared to iron constructions became a competitive disadvantage that the concrete companies tried to fight with own research. The engineer Emil Mörsch, for example, developed as employee of Wayss & Freytag a "theory of reinforced concrete construction" which was published in 1902. Its enormous success mainly resulted from the verification by series of testings. With the appointment of engineers from leading concrete companies as professors at technical universities the development of theories of concrete construction in connection with systematic experiments became subject of the academic field.

The paper focuses on the actual development of experimental cultures in Germany in the 19th and early 20th century as well as on the means by which the results were spread such as pointed texts or photos.

Christoph RAUHUT | ETH Zurich, Switzerland

Construction sites as spaces for experiments in the late nineteenth century

Up to the 19th century the set of rules for building were deduced mainly empirically. Knowledge on construction was primarily gained through personal experience and remained at an implicit status. Thus innovation in building construction was mainly derived by the empirical procedures on site – to exaggerate: the construction site exclusively inherited the 'experiment' in the building sector. This bias changed at the latest in the 19th century: Institutional changes, as the foundation of the École polytechnique in the late 18th century and following up Polytechnic Schools in the German states; the redefinition of building knowledge as a scientific one in the modern sense; the upcoming of material testing as a discipline; and further developments resulted in a redefinition of experiments in the technical sector and especially in the building sector:

In the first place construction knowledge was no longer derived exclusively on the construction site, but was being "invented" on paper; gained through "experiments" in the laboratory; or taken from adjacent disciplines such as engineering. The enormous wealth of technical literature in the 19th century might be one illustration for this shift. As a result the construction site newly "acted" as a practical testing field: Novel construction techniques such as the famous 'Holzementdach' were being tested "in real"; new materials such as industrial glazes for wood surfaces or glass bricks for translucent walls were used first. The construction site became a field of experiments in regards to application and implication. Nevertheless, in certain areas the original, empirical character still remained on the construction site, as building in the (late) 19th century was in a transitional state – as was the role of the experiment.

The proposed paper aims to describe the status of the construction site as a field for experiments. Looking at archival material of construction sites such as the daily records in conjunction with reports on experiments on construction sites in the journals of the time, the discussion of practical instances might serve as starting point to illustrate the shift. The sketch of broader, underlying developments will position the role of the construction site itself. The focus of the paper will be on construction sites of the prevalent buildings of the city in the 19th century, such as flats, schools or churches; these sites not only account for the dominant number, but they also display the 'amplitude' of different building techniques. A geographical limit of the research will be the region of Zurich, Switzerland, as the paper will also present first results of the author's dissertation project.

Commentary: Torsten MEYER | ETH Zurich, Switzerland

P125. Enforced specialization in computing technology: debugging the history of cooperation and competition in COMECON countries

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Tue 23 July, 09:00–10:30 • Uni Place 4.206

Symposium organisers:

Helena DURNOVA | Masaryk University, Brno, Czech Republic

Slawomir LOTYSZ | University of Zielona Gora, Poland

Symposium abstract

The Council for Mutual Economic Assistance, abbreviated as COMECON (or CMEA), was founded in January 1949. Early on, in April 1949, COMECON countries adopted the policy of sharing the results of research and development: each signing country was obliged to make the results of their research available for free to partners. Officially, COMECON also declared interest in co-operation with non-COMECON countries. Already in 1952 an agreement had been reached on sharing knowledge and patents when called upon by fellow COMECON members. It seems the importance of expertise was recognised as an important asset and its exchange was forced under the veil of the statement that knowledge belongs to everybody.

In computing technology, a stronger consensus on scientific and technical co-operation was put into actual practice in December 1968 by an initiative that would eventually lead to the production of compatible computers. The new industry, aiming at the production of key technologies, was chosen to foster a new level of "Socialist economic integration", in one single move strove to level the emergent European Union in terms of economic integration and to meet multinational corporations like IBM in terms of producing large technical systems. To make the co-operation work, different countries were to specialise (and become the experts) in different fields. For example, in the mid-1960, when COMECON countries were beginning to discuss co-operation in producing computers, Czechoslovakia offered its tape readers and Romania was entrusted with the design of the central unit.

The decision to entrust production of certain commodities to one of COMECON countries were often quite irrational and caused tensions instead of promoting the spirit of "fraternal" co-operation. An excellent example of this is the case of Polish-Czechoslovakian collaboration in the production of tractors, where Poles had to give up their newly designed model of Ursus tractor after the communist party members learnt about advantages of the Czechoslovakia Zetor tractor. Engineers in both countries were not happy about this, as one side had worked in vain, while the other was forced to share their know-how. The session will look at how specialisation (i.e. making some groups of engineers to feel special) was promoted and how it was framed with respect to special ties of some of COMECON countries with the Western world (like in Romania-France case).

The papers will offer detailed analysis of phenomena involved in such co-operation, including seeking allies from outside Comecon and exploiting specific advantages.

Chair: Thomas HAIGH | University of Wisconsin-Milwaukee, United States

Pierre BOUILLON | École spéciale militaire de Saint-Cyr, France

A paradoxical Franco-Romanian cooperation in computers, both supported and circumscribed by the Cold War

My paper will focus on the relationship between France and Romania in the field of informatics in a particular period, the Détente. I will lean upon various sources, depending on the archives of a French firm, the CII (Compagnie Internationale pour l'Informatique), and of French public administrations: the ministries of Foreign Affairs, of Finances, of Defense and of the Industry. I will demonstrate that the Franco-Romanian cooperation was both supported and circumscribed by the Cold War. Indeed, it was Romania's peculiar stand in between the Soviet bloc, allegedly autonomous, which allowed France to develop this cooperation in a high technology field. Without the peculiar time of Détente, which favored the building of scientific, technical and industrial links between Eastern and Western countries, this would not have been possible either. Finally, these considerations were combined with the French desire to resist United States' hegemony in informatics. If Franco-Romanian ties were exclusive at the beginning, the French industry – backed by the French government – had in fact to compete more and more with the American industry and government. On the contrary, both France and the United States stood cautious of teaching the most up-to-date discoveries of their own Research & Development to the Romanian engineers they had to train and, sometimes, to receive in their own country. Actually, the Soviet-Romanian cooperation in the field of technology intelligence kept being felt a menace for the West. Though, it was paradoxically when this worry proved the most pregnant that the cooperation was set up.

Slawomir LOTYSZ | University of Zielona Gora, Poland

Plaiting a whip of sand: ups and downs of optical fiber technology in pre-1989 Poland

An old Polish proverb uses the "plaiting a whip of sand" parallel to picture a highly improbable venture; something, which simply cannot succeed. And since the early optical fibers were indeed made of quartz glass, it appears to be the most appropriate description of the fates of optical fiber technology in Poland. It was developed independently by Polish scientists in the mid 1970s, what placed the country alongside such pioneers of that optical fibers as France and Japan. Needless to say, Poland was the first among COMECON countries to possess such technology. For a number of reasons the news of such an achievement should be regarded as advantageous. The commonwealth of socialist countries gained access to the technology of potentially great strategic importance, crucial in the development of computer and communications technologies. But in centrally controlled, which pushed toward the economic integration of the socialist countries in spite of individual, sometimes contradictory interests, it could also mean troubles and discontented partners. Specialization of production, so highly esteemed in COMECON, did not assigned telecommunication equipment to be produced by Poles, at least to that extent they could think of in the case of optic fibers. "Fortunately" for the status quo, Poland was not able to launch production as a result of internal difficulties, namely the rivalry and misunderstandings between people and institutions. The paper gives a critical view on the very unique case, when independently developed modern technology caused more trouble than profit to the licensing-orientated economy.

Petri PAJU | University of Turku, Finland

Finlandized computing or business as usual? Computer trade between Finland and the Soviet bloc in the 1970s

The intensified COMECON cooperation in computer production from the late 1960s was paralleled with increased Soviet-Finnish cooperation in the same field. For the Finnish part, it was scientists and private

enterprises that became most involved with the Eastern bloc computing during the 1970s. Their interactions with the Soviet bloc counterparts tell a story of cooperation and competition based in a (non-aligned) country balancing between the cold war Western and Eastern influences. One of the reasons why Finland was interesting for the Soviet experts as well as for the intelligence body KGB was because IBM had a Finnish subsidiary that could operate freely, but Finnish IBMers also grew interested in the Soviet markets when the IBM World Trade began discussions and then doing business with the USSR in 1971. Therefore through IBM Finland (and its parent organization) one can study how IBM viewed and possibly responded to the COMECON project of producing and selling its series of "IBM-compatible" computers. In 1974, Elorg Data Company was established as a Soviet-Finnish joint enterprise. The Finnish partners involved Nokia Company and a major bank, the Soviet side the V/O Electronorgtechnica (which owned 58 per cent) and a petrol company. The purpose of the Elorg Data was to market and sell computers made in the Eastern bloc, especially the Unified System computers, to customers in Finland. Thus, this Soviet export effort and its products encountered Western type of competition in the Finnish markets. Curiously, Elorg Data also cooperated with IBM Finland when the former bought or leased IBM equipment to its computer center in Helsinki. In addition to the trade relations that also involved some Swedish players, the Soviet national security agency KGB apparently considered Finland a fruitful place to collect information on the latest Western computer technology. With some archival sources on KGB's interest in IBM, this paper aims to consider the usefulness of the concept of Finlandization, i.e. bending to the requests of a neighbouring superpower, as a possible explanation for the increased influence of the Soviet Union in the field of information technology in Finland and perhaps elsewhere in the 1970s.

Frank DITTMANN | Deutsches Museum, Germany

The development of network technology in COMECON countries

Today's Internet rests upon not only on highly developed computer technology. The Internet bases as well on data transmission on public telephone networks which is indispensable for it. Nevertheless computer communications have been considered less in the major history of computing. To a greater extent this lack has to be recognized in the history of computer networks technology in Eastern Europe. Already in 1953 specialists of the Institute of Precision Mechanics and Computer Machinery in Moscow started developing a computer-based missile defense system in which radar signals had to be transmitted to central computers over long distances. In the 1960s in USSR and other COMECON countries more and more networks for civil purposes had been developed, in particular at large scientific institutes, e.g. the Joint Institute for Nuclear Research in Dubna or the Institute for High Energies Moscow. In 1969 the decision to produce the Rjad computer system which was modeled on the IBM 360 system led to stronger orientation of Eastern computers on Western technology. However, there existed a time gap of some years. Additionally, in the 1960s increasingly computer systems were used for civil purposes. In particular the political leadership hoped to improve the central planning system by using data processing machines. Consequently the Rjad system had been completed with several data transmission components. Furthermore since the 1970s, at nearly all COMECON countries, universities and institutes of the Academies of Science built up computer networks. Similar to the West those local networks were connected via the public telephone system. The paper deals with the opportunities and the limits of computer networking in COMECON countries. It discusses technical and economical problems.

Q127. ICOHTEC special topics in the history of technology

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Thu 25 July, 09:10–Sat 27 July, 10:40 ▪ Schuster Bragg

Organiser: Timo MYLLYNTAUS | University of Turku, Finland

Q127-A

Thu 25 July, 09:10–10:40 ▪ Schuster Bragg

Chair: Antoni ROCA-ROSELL | Universitat Politècnica de Catalunya - Barcelona Tech, Spain

Lars BLUMA | Deutsches Bergbau-Museum, Germany

Miner's workplace and the hygiene movement in the German empire

Using the Foucaultian concept of biopolitics this presentation examines the scientific and medical objectification of the workers' bodies in mining on the Ruhr as an integral part of the formation of a modern care and control regime. This specific control regime had been established with the modernization of the health insurance for miners at the end of the nineteenth century. Central assumption of this paper is that in the German empire new knowledge about the miner's body arose within the scope of the categories and paradigms of the hygiene movement. Above all this means that the miner's body, in particular his productivity and health, was analysed and categorised in relation to his working and everyday life environment. This specific form of hygienic objectification of the miner aimed at the production of a healthy environment as well as at the production of a hygienic subject. Indeed, this environmental-hygienic approach was to be complemented with a new scientific discipline at the turn of the century, namely bacteriology or more precisely bacteriology-oriented hygiene. The fight against the hookworm disease around 1900 and the extension of the medical infrastructure of the health insurance for miners will be taken as examples for this important watershed of biopolitics in industrialized Germany.

Maria Elvira CALLAPEZ | CIUHCT-University of Lisbon, Portugal

Ernst HOMBURG | Faculty of Arts and Social Sciences, University of Maastricht, Netherlands

Safeguarding the Plastic's Heritage

This paper aims to analyze the technical-scientific, industrial, social history of plastics and its impact on society, since the 1910's.

Plastics, initially conceived as products to replace and imitate natural materials, acquired such a degree of development that there is practically no field of activity where they are not employed. In competition with traditional materials (metals, wood, ceramics, wool, etc.), plastics soon attained a prominent position due to their characteristics and the pace at which better materials, processes and new applications were developed. This development was not only the result of advancements in science and technology, but also a contribution to the progress of these areas. The need to solve problems through the development of plastics, as well as to achieve materials with certain characteristics has led to research that led to advances in other areas of science and technology. As a consequence, the plastics industry has come to occupy a prominent place in the economies of industrialized countries since the inter-war period until the present day.

The paper will reflect on how this development should be put on display in museums with important collections of plastics objects. Starting with Bakelite, mass consumption of plastics products emerged, that later was taken over by thermoplastics such as polystyrene, polyvinyl chloride, polyethylene, 'acrylics', and 'Teflon'. After World War II, many first-

generation objects eventually disappeared, so it is therefore important to collect and preserve them, and put them on display.

Special attention will be devoted to some Portuguese collections of materials. Baquelite Liz, for instance, a Portuguese company that has worked in this area since 1940 in Leiria, the birthplace of the plastics manufacturing industry, has a wonderful collection that can serve as the basis for a future museum.

Anthony N. STRANGES | Texas A&M University, United States

Roger Revelle answers the question, how deep is the ocean?

In 1932 the New York City composer and lyricist Irving Berlin (1888-1989) wrote the song *How Deep is the Ocean?* Berlin was fantasizing about the unending depth of attraction that people in love have for one another. Thirty-five years later in 1957 Roger Revelle (1909-91) and his colleagues at the Scripps Institute of Oceanography in La Jolla, California, asked the same question but in an entirely different context. They found that the ocean wasn't very deep in carbon dioxide. Contrary to what most scientists believed at that time the oceans did not absorb and dissolve an unending quantity of carbon dioxide, a known greenhouse gas. Instead the dissolved carbon dioxide formed a thin layer at the ocean's surface and prevented additional carbon dioxide from dissolving. The oceans were buffered solutions. Much of the increasing amounts of carbon dioxide passing into the atmosphere remained in the atmosphere, increasing the atmosphere's concentration of carbon dioxide and the rate of global warming. This paper will examine the research that led Revelle to this startling conclusion and the impact his research had on the scientific community's understanding of global warming.

Peter KOVAL | Humboldt Universität zu Berlin, Germany

Cleanrooms of knowledge. Why is the Moore's Law exponential?

According to David Brock, the original prediction of Gordon Moore which became later known as the Moore's Law was just 'one voice' among many in 1965. In the proposed paper I would like to discuss the historical and technopolitical possibilities of this discursive formation. The development and production of the electronic radio proximity fuze during the WWII proved that the electronics can be made not only more robust but also significantly smaller, more powerful and cheaper. With growing complexity of us-military electronics after the WWII the reliability of the electronic (weapon) systems became critical. While solving the economical (development, maintenance) and technological (growing complexity) reliability problems, new knowledge of electronics emerged. At first the knowledge of electronics – getting smaller, more complex and cheaper – was formalized so that mathematical (statistical) methods could be applied to the reliability problem. As a result the first 'exponential law' of electronics was formulated in 1953 by Richard Carhart. With time, 'integration' and 'miniaturization' became prevalent solutions to the reliability problem. Drawing on historical observations many prospective techno-economical predictions of growth – in terms of complexity, miniaturization and cost – were made. In this predictions the knowledge of economists and cutting edge insights of engineers were put together to formulate the possibilities and limits of future growth. The analysis of the engineers' discourse in the 1950s and early 1960s shows also that the exponential curve became common visual representation in such predictions.

Q127-B. Knowing users: social demands in shaping technology and designing products

Thu 25 July, 11:10–12:40 • Schuster Bragg

Chair: Artemis YAGOU | Deutsches Museum, Germany

Annika MENKE | Technical University Munich, Germany

WITHDRAWN: Scanning the s(h)elf: Scanning technology and retailers' expertise of consumers in Germany 1970s to 1990s

Constantin CANAVAS | Hamburg University of Applied Sciences, Germany

Public Access Defibrillator: Shaping a medical instrument for layman use in the public sphere

Public health considerations and medical evidence concerning resuscitation practice in case of heart fibrillation motivated initiatives of installing Automatic External Defibrillators (AEDs) as public-access emergency medical devices in places with high public frequency such as train stations, airports, shop malls etc. Originally a high-tech medical device in the hands of experts the defibrillator had to be reshaped for layman use in the public sphere. The goal of the study is to reconstruct the history of the development of the public-access device in relation to the evaluation criteria. It can be shown that a great deal of the initial controversy was associated with the notorious neglecting of the distinction between *efficacy* assessment (with respect of the device performance under controlled conditions) and *effectiveness* assessment (with respect of the performance under every-day-life conditions). In order to overcome the laymen deficit in handling the medical instrument the technology design stressed a communication form based on evoking expert knowledge by oral recommendations to the user through the device itself. The unknown user was replaced by the dictated layman dummy constructed by the expert discourse. The further choices concerning the framing of the installation vary according to the negotiations among the interest groups involved in the decision procedure. In most cases the compromise consists in concepts that presuppose a limited group of potential users with a minimum of experience or special defibrillation training.

Wolfgang KÖNIG | TU Berlin, Germany

Success and Failure. Alois Riedler's Attempts to Integrate Theory and Practice in German Engineering Education Around 1900

Alois Riedler (1850-1936) was one of the most prominent professors of mechanical engineering in the Kaiserreich and in the early Republic. Under his influence, the 'Technische Hochschulen' built machine laboratories and received the right to confer doctorate degrees. Usually, Riedler is considered to be a proponent of a practice orientated approach in engineering education. In my paper, I shall give a revised version of this interpretation. I emphasize that Riedler tried to integrate theory and practice in engineering education in a new way in order to overcome the ongoing process of specialization.

Around 1900, Riedler succeeded in establishing new curricula in mechanical engineering at the 'Technische Hochschule Berlin'. Nevertheless, he was not satisfied with the further development of engineering education. Therefore, after the First World War, he tried to institutionalize a competing second department at the 'Hochschule' in order to try out his concept. This failed finally due to his his colleagues' opposition and the lacking support from the ministry of education and from industry.

My paper will integrate this case study in the general history of German engineering education in the 19th and 20th century. It will consider the various actor groups, their ideas, interests, and politics. The paper is based on research in the state archives and in the actors' papers. Besides this qualitative approach, the transformations of the mechanical engineering curricula at the 'Technische Hochschule Berlin' will be analysed quantitatively.

Vahur MÄGI | Tallinn University of Technology, Estonia

Technology Studies in Estonia: Directions and Organisation

When the Faculty of Technology was established at the University of Tartu at the beginning of the 19th century, expectations were primarily directed toward offering new ideas and invigorating agriculture. Carl Schmidt, Professor of Chemistry at the university, announced by virtue of the experience he had obtained on a work trip to England that his laboratory would be open to the industry. At the same time he started to explore the feasibility of using obolus phosphorite in the production of fertilisers and was accordingly interested in the oil shale resources located in Northern Estonia. The chemical composition of oil shale was for the first time analysed by Georg Petzholdt and Alexander Schamarin in Tartu. The pioneering institution to commence the investigation of the combustible properties of oil shale was the State Central Laboratory in Tallinn. This line of work was continued by the National Testing Centre. Distilling furnaces developed in Estonia received international recognition. Australia was the first country to commence production of shale oil by adoption of the Estonian technology. After World War II, all branches of technological research were assembled into the Academy of Sciences and Tallinn University of Technology. Studies were continued in the field of oil shale, power engineering, and civil engineering. By the reform of the university system in 1992 the research laboratories were restructured and brought under the jurisdiction of institutes. The variety of research topics has been mostly implicated by the powerful emergence and spread of information technology.

Q127-C. Just applied science? The origins of technological knowledge

Sat 27 July, 09:10–10:40 • Schuster Bragg

Chair: Alexandre HERLEA | Université de Technologie de Belfort-Montbéliard, France, France

Jan KUNNAS | University of Stirling, United Kingdom

Reversal and circular technology transfer

Technology transfer is usually described as something going from developed countries to developing countries or from the interior to the periphery or from “advanced” to “backward” areas. In a forthcoming article, I have challenged this conventional view by presenting some pre-industrial examples of traverse technology transfer – from the periphery to the periphery. In this presentation, I will take one step further by arguing that technology was also transferred in a reversal direction, from the periphery to the interior. My example for such transfer takes the form of a plant; The rutabaga or swede (*Brassica napobrassica*) that was introduced from Sweden to Scotland in the 18th century. From there it spread to the rest of Great Britain, and became an essential part of the advanced Norfolk-four-course cultivation method, as it was more frost-resistant than the common turnip used in cropped fallow. Eventually, it was taken into cultivation also in France, German and North-America. The circle was closed, as advanced British cultivation methods spread to Sweden. Thus, I will also show that there also existed a circular technology transfer. This is my final nail in the coffin for a view of technology transfer as an one-way process going solely interior to the periphery. My paper also gives some insights to the question posed in the subtheme: Just applied science? on the origins of technological knowledge. It puts the view that technological knowledge only springs from applied science into the same coffin. It does this by showing that technological knowledge can also be acquired through a normal learning by doing process.

Eduardo PEREZ-MOLINA | Universidad Politecnica de Madrid, Netherlands

Methodology to Identify the Roots of a Technology based on the body of Patent Literature

The purpose of this work is to identify the technologies at the origin, the technological problems encountered and the solutions proposed which lead to the particular technology under study. Our methodology is based on the hypothesis that the documents cited in the search reports by patent examiners against patent applications in a particular (new) technology link the new emerging techniques to the conventional existing ones, and therefore an analysis of these documents will point to the roots of that (new) technology. Furthermore, it uses at different levels two main elements of the body of patent literature, namely prior-art lists of documents and classification codes. Firstly, identifying patents related with the particular technology using classification codes, then going backwards in time through the network of associated citations and finally, identifying technologies using again classification codes at different levels of aggregation. We have focused on patent publications because they have two features that in our opinion make patents particularly attractive for the study of the evolution of technology, namely each patent is published with classification codes and with a list of related prior-art documents. Both features are given by the patent examiner after an examination (the “search report”) totally independent of the author. Our methodology seems new and complements works based on the pioneers experience and academic sources. Although for illustrative purposes we have applied our methodology to find the roots of computer graphics, it appears to have the potentiality to be applied to find the roots of other technologies.

Vitaly GOROKHOV | Institute of Philosophy of the Russian Academy of Sciences, Russia

WITHDRAWN: Galileo as philosopher of technology: the origins of the scientific-technological knowledge

Robert BELOT | Université de Technologie Belfort Montbéliard, France

The polarisation in France between “pure” science and the “applied” science of inventors and engineers: a cultural and political view of the Académie des Sciences from 1919 to 1939.

In a certain French tradition – at least since the nineteenth century, when research became increasingly institutionalised and professionalised – technology has suffered from an image deficit. This tradition is based on a deep dichotomy between “open” research and “captive” research, between science, seen as disinterested and universal, and its “applications”, seen as “impure” due to their links with the market and the state.

This situation probably reflects a kind of implicit hierarchy that locates technological knowledge in a position of dependency on the majesty of science. Technology has negative connotations in the public imagination because of the huge negative power attributed to it. It is common in France to warn of the risk of “pure” knowledge being absorbed in the parasitical complex of technological knowledge, and of “pure” science being absorbed in the formless, similarly parasitical complex of “technoscience”.

Through the French Académie des Sciences’ own words, we aim to show that the two world wars, with the patriotic and political mobilisation they caused, played a decisive role in the evolution of scientists’ views on the issue of how their research was used, with the myth of “pure science” but also of “scientists working in industry and helping to introduce scientific methods to industry”. A grassroots movement began in 1916, culminating in 2000 with the creation of the Académie des Technologies. The moment we wish to emphasise came between the wars. The economic crisis reactivated the dichotomy between science and its applications. The Académie denounced “the several

distinguished minds who cast doubt on the hitherto unquestioned human importance of Science and its applications” by blaming it for the unemployment and poverty due to the progress of mechanisation. But as soon as the Nazi threat became clearer, the great figures of science (such as Jean Perrin and Joliot-Curie) accepted the process of mobilising science. The power of technological knowledge regained its legitimacy.

It is both this cultural polarisation between the scientist and the inventor, which crystallised in the mid-1930s, and the process by which it was overcome (resulting in the foundation of the Centre national de la recherche française in 1939) that we wish to analyse. The work is based primarily on the reports of the Académie’s “secret committee” and on the published reports.

S129. Islamic astronomy in its cultural context

Sponsoring bodies:

CHAMA: DHST Commission for the History of Ancient and Medieval Astronomy

CHOSTIS: DHST Commission on History of Science and Technology in Islamic Societies

Wed 24 July, 14:00–17:30 ▪ Schuster Blackett

Symposium organisers:

Josep CASULLERAS | Universitat de Barcelona, Spain

Robert MORRISON | Bowdoin College, United States

Symposium abstract

Within Islamic civilization, the sciences of the stars have attracted the most scholarly attention over the years and have also been the locus for some of Islamic societies’ most notable achievements. Therefore, CHOSTIS and CHAMA have collaborated on a special session entitled ‘Islamic Astronomy in its Cultural Context’. This panel covers a remarkable range of topics, from theoretical astronomy, to handbooks with tables, to astrology.

S129-A. Cosmography and hay'a

Wed 24 July, 14:00–15:30 ▪ Schuster Blackett

Chair: Jan HOGENDIJK | University of Utrecht, Netherlands

Josep CASULLERAS | Universitat de Barcelona, Spain

The description of the cosmos in tenth-century Al-Andalus

In this presentation I will revisit one of the oldest Andalusí astronomical sources to have come down to us: the Kitāb al-hay'a, written in the tenth century by the Cordoban author Qāsim b. Mutarrif al-Qattān. The text, preserved in the Süleymaniye Library in Istanbul (Carullah Efendi 1279, folios 315r–321v) is organized in 30 chapters, and their contents can be arranged in three different groups: (1) Materials with some kind of practical utility, related to astrological purposes, religious worship, measure of time, calendar, or certain elements of meteorology; (2) Materials which are more closely linked with mathematical astronomy, a field which dramatically evolved in eleventh-century al-Andalus; (3) Materials dealing with the physical structure of the universe. On the whole, this work is a representative example of the sort of astronomy that was practiced in al-Andalus in that day and age. Several parts of it have been studied some time ago. However, other parts still await for a deeper investigation to determine their significance, as they are the first evidences of the introduction into al-Andalus of a range of scientific

traditions. We find in the Kitāb al-hay'a materials coming from the ancient Greek, Babylonian and Indian sources that had been compiled in the Islamic East, together with some elements of an old Latin tradition. These last elements, which were probably in use in the Iberian Peninsula, have a major interest because they may help us to understand, in some fashion, the special character which the astronomical research conducted in al-Andalus would later acquire.

Taro MIMURA | University of Manchester, United Kingdom

Planetary models in pseudo-Mashā'allāh's *Liber de orbe* in the early 'ilm al-hay'a tradition

Ptolemy's *Almagest* was translated into Arabic in the mid-9th CE. Based on this attainment, Islamic scholars worked on the quantitative determination of planetary motion. Besides this work, they also articulated qualitative and physical cosmology by using composition of celestial spheres inspired by the Ptolemaic planetary models. This genre of astronomical research was called 'ilm al-hay'a. One of the earliest books in this genre was Ibn al-Haytham (965-ca. 1040)'s *On the Configuration of the World*, and later it was canonicalized by Naṣīr al-Dīn al-Tūsī (1201-1274) in *Tadhkira fī 'ilm al-hay'a*.

Development of the 'ilm al-hay'a implies that Islamic scholars paid profound and systematic attention to physical cosmology. Then, how did these scholars foster the 'ilm al-hay'a, after the Arabic *Almagest* till it was accumulated in Ibn al-Haytham's work? Studying this early 'ilm al-hay'a tradition is essential in obtaining the whole picture.

Due to the scarcity of available documents, research on the early 'ilm al-hay'a tradition is not an easy task. While most of few materials available are fragmental, there is a rare source containing rich information on physical cosmology written before Ibn al-Haytham: *Liber de orbe* attributed to Mashā'allāh (ca. 815). Since this work had long been considered as remaining only in the Latin translation, however, its importance as an early 'ilm al-hay'a work had not been well-recognized, probably except for D. Pingree and J. F. Ragep.

Owing greatly to my privilege as a member of the “Rational Sciences in Islam” project (McGill) until 2012, I managed to find two manuscripts of the Arabic original of the *Liber de orbe*: Berlin, Staatsbibliothek zu Berlin, Ms. or. oct. 273, and Philadelphia, Pennsylvania University Library, MS LJS 439. Moreover, in the Arabic text, I found that the author gave an example of solar eclipse occurred in 938. This contradicts the attribution to Mashā'allāh, and instead, makes it plausible to be written just after the eclipse in 938, for he chose this example as an incident still freshly remembered by its readers, to support his explanation about time difference of occurrence of solar eclipse in different places. It should also mean that the *Liber de orbe* belongs to the early 'ilm al-hay'a tradition.

In this presentation, I attempt to illustrate the details of planetary models explained in the *Liber de orbe* by analyzing the Arabic original, and to determine the significance in the early 'ilm al-hay'a tradition.

Marc OLIVERAS | Universitat de Barcelona, Spain

Ancient Arabic cosmography on the sources of the river Nile

As we know, the *Jibāl al-Qamar* (*Montes Lunae*), are the mountains within the African continent where the ancient geographers located the sources of the river Nile. Like other many ancient sciences, geography was not always understood without the help of mythology, and the *Jibāl al-Qamar* provides a good example of this.

Muslim geographers did not use proper mythological stories like the Greek tradition, but often they take use of symbols and allegories as seen in the literary genre of Arabic *mirabilia* ('*ayāib*). Geography not escape Islamic literary productions originated by Greek rationalism, as happens in the transmission of Ptolemy's Geography, known by the Arabs (c. IX) long before the Europeans (c. XV). This paper aims to deal with these topics on the sources of the river Nile: early mentions, main descriptions, mythology and surveys.

Key words:

Jibāl al-Qamar, *Montes Lunae*, early geography, Nile, Africa, cosmography

S129-B. Observational astronomy and its applications

Wed 24 July, 16:00–17:30 ▪ Schuster Blackett

Chair: Josep CASULLERAS | Universitat de Barcelona, Spain

Julio SAMSÓ | Universitat de Barcelona, Spain

Meteorological astrology in the Muslim West

In the first half of the 15th century, a Moroccan astronomer and astrologer called Abu ḥabd Allah al-Baqqar wrote two books entitled *Kitab al-adwar fi tasyir al-anwar* (Cycles for the progression of the luminaries) and *Kitab al-amtar wa l-asḥar* (On rains and practices). The first book, written in 821/1418, has been edited by Montse Díaz Fajardo and it contains materials of astronomical significance related to the crisis of the Andalus⁺ astronomical school which dominated the Maghrib during the 13th and 14th centuries and was later replaced by the influence of Eastern z⁺jes (Muhyi al-Din al-Maghribi, Ibn al-Shatir and Ulugh Beg).

The Book on Rains and Prices is purely astrological and it deals with a Western tradition of astrological meteorology entirely different from the method of weather forecasting in al-Kindi's writings studied by G. Bos and Ch. Burnett (London, 2000). An edition of the only extant manuscript (Escorial 916) has been prepared by Chedli Guesmi and we are both occupied in writing a detailed summary and commentary of its contents.

The book is divided into four parts:

- 1) 1) Introduction: Science and religion on the problem of astrology. Three different attitudes on regard to astrological predictions and its orthodoxy.
- 2) 2) Weather forecasting as a result of the position of the superior planets according to the school of the ancient authors of the Iberian Peninsula and the Maghrib who used the so-called "method of the crosses". This part of the work probably corresponds to the introduction in al-Andalus of a late Latin work on astrometeorology, known since the beginning of the 9th c., and al-Baqqar's text contains a good collection of passages which derive from the same Arabic source translated by Alfonsine collaborators in the *Libro de las Cruces*.
- 3) 3) Prognostications of the weather for the whole year as a function of the displacement of Saturn through the twelve zodiacal signs. One of the main sources quoted is the otherwise unknown *Lamiyya* (poem ryming in /) by the 11th century astrologer Ibn al-Jayyat, a disciple of Maslama al-Majriti, who wrote the poem c. 1050. On the whole, al-Baqqar is collecting, in this part, materials from different sources and tries to show that weather forecasting cannot be based in simple criteria like the motion of Saturn through the zodiacal signs.
- 4) 4) Predictions on fertility, draught, prices and rains throughout the years in agreement with universal horoscopes (*al-nasabat al-kulliyya*) on which there is agreement among ancient astrologers. This part is divided into three chapters: a) on meteorology and rains; b) on prices and c) on predictions (sometimes unrelated to rains and prices) based on solar and lunar eclipses.

Petra G. SCHMIDL | Universität Bonn, Germany

al-Ashraf Umar's description of the zodiacal signs

In 13th century Yemen, the Rasulid sultan al-Ashraf Umar (d. 1296) – the authorship is not yet completely established – wrote an astronomical and astrological handbook. In the first chapter, he introduces the zodiacal signs. The sultan discusses their figures and natures, as well as other objects and characteristics attributed to them, e.g. animals, plants,

countries, and colours. At the first glance, it appears that al-Ashraf Umar provides standard information that other authors also described earlier in their astrological introductions, e. g. Abu Ma'shar (b. 787 (?)), al-Qabisi (fl. 10th c.), and Kushyar b. Labban (fl. 10th / 11th c.). In this paper, I will present a selection of the objects and characteristics that al-Ashraf Umar attributes to the zodiacal signs, and compare it with similar sections in astrological introductions. This comparison will allow learning more about the state of astrological knowledge of the sultan and in 13th century Yemen. It will shed light on the sources that al-Ashraf Umar used for his handbook to introduce the science of the stars to those who are not that familiar with this topic.

María José PARRA | Universitat de Barcelona, Spain

Some new data about the manuscripts that contain the Arabic translations of Abraham Zacut's *Almanach Perpetuum*

Zacut's *Almanach Perpetuum*, printed in Leiria in 1496, was translated into Arabic at least twice: by Mūsā Jālīnūs, in 1505-06, in Istanbul, and in the Magreb by al-Hajarī (ca. 1624). Mūsā Jālīnūs's translation is only extant in one manuscript (Escorial 966) which seems to bear witness to its limited diffusion. Al-Hajarī's translation is preserved in at least five manuscripts and it was the object of some recensions and commentaries which accompanied the numerical tables. I will concentrate my analysis on them. These manuscripts are: -MS Milan Ambrosiana 338 (C82). Canons: Fols. 1r-20v. Numerical tables: fols. 21r-149r. -MS Ar. Vatican 963. Canons: 1r-27v. Numerical tables: 38v-166v. -MS Rabat Hassaniya 8184. Canons: 21 unnumbered pages. Numerical tables: 260 pages. -MS Rabat Hassaniya 1433, Canons: Fols. 5r-9v. Followed (fols. 9v-10r) by an extra chapter on lunar eclipses copied from 'Abd al-Rahmān al-Fāsi's risāla. It also contains a summary of al-Hajarī's translation (fols. 11v-15rv). -MS Cairo National Library DM 1081, Canons: pp. 9-19. Numerical tables: 329 pages. The manuscript contains three risalas and the second one corresponds to al-Hajarī's translation. The other two texts are two different collections of Maghribi canons of the *Almanach's* tables which include materials (pp. 1-2) from the *Risāla 'arabiyya* by the faqih and mu'addil Sidi 'Abd Allāh Asnāk al-Marrākushi (fl. ca.1655), and the *Tuhfat al-muhtāj fi 'ilm al-ta'dil wa 'l-azyāj*, (pp. 20-28) by 'Abd al-Rahmān al-Fāsi (Fez, 1631-1685). Other manuscripts are commentaries to the Hajarī's translations: -MS 2027 and MS 2014: Library Jizāna al-'Amma (Rabat). -MS 1331: Rabat Hassaniyya. I have explored the transmission process between these manuscripts, and I will show the conclusions I have reached after editing and studying these texts, the astronomical tables and the information contained in the marginal notes. I have also been able to undertake a codicological exploration on the original manuscripts and I have found important clues to establish a stemma of the textual transmission. These manuscripts bear witness to the enormous diffusion of Hajarī's translation, which was used until the nineteenth century throughout the Arab world (from Morocco to Yemen). My work here is an extension of the published meticulous researches made, on the one hand by Julio Samsó and, on the other, by Chabás and Goldstein.

W131. 32nd Scientific Instrument Symposium

Sponsoring body:

SIC: DHST Scientific Instrument Commission

Tue 23 July, 09:00–Fri 26 July, 12:30 ▪ Schuster Rutherford

Symposium organiser: Sara SCHECHNER | Harvard University, United States

Symposium abstract

Every year, the Scientific Instrument Commission holds an annual Symposium in a locale with significant historical collections. This year the XXXII Scientific Instrument Symposium will take place in Manchester, United Kingdom, as part of the 24th International Congress of History of Science, Technology, and Medicine.

The primary theme of this year's Symposium takes inspiration from the congress theme, 'Knowledge at Work,' but with a focus on the 'Trade and Transfer of Scientific Instruments.' To put knowledge to work, instruments—and the knowledge they embody or generate—frequently change hands. This transfer could be between individuals, manufacturers, retailers, institutions, countries, Europe and the Americas, or other pairings.

Other paper topics have also been welcomed in this Symposium (as is the practice of the Scientific Instrument Commission). These broadly concern the history of scientific instruments; the preservation, conservation, or documentation of collections of instruments; or their use within the wider disciplines related to scientific heritage, material culture, and the production of knowledge. These papers are clustered together in thematic sessions.

W131-A. Trade and transfer of scientific instruments, part 1

Tue 23 July, 09:00–10:30 ▪ Schuster Rutherford

Chair: Silke ACKERMANN | Baltic College University of Applied Sciences, Germany

Stephen JOHNSTON | University of Oxford, United Kingdom

Instruments between England and Morocco: mathematical exchange in 1600

In 1600 the noted English navigational author, mathematical practitioner and sometime Cambridge fellow Edward Wright received a letter from Morocco. Sent by his brother-in-law Thomas Bernhere, it provided detailed suggestions for mathematical instruments that Wright might profitably send to the court of the Sa'ad ruler Ahmad al-Mansur. The letter provides a remarkable window onto the rich relationships between trade and gift-giving across late Renaissance cultures. Clearly well-informed on the range of Wright's instrumental innovations, Bernhere not only recommended specific devices for the Sultan and others at court but even gave instructions on how and where they might most effectively be made. The letter travelled with an embassy sent from the Moroccan court to negotiate a military alliance with England against Spain. Although unsuccessful in its mission, this immediate context indicates that Wright's mathematical instruments were envisaged as playing a larger role within diplomatic relations. The letter not only illuminates English ambitions but raises questions about the interest of Ahmad al-Mansur in European astronomy and instruments. He spent much of his youth in exile within the sphere of the Ottoman empire and would have been familiar not only with the construction of Taqi al-Din's observatory in Istanbul during the 1570s, but also with the lavish instruments now attributed to Gerard Mercator which were made for Sultan Murad III. The Moroccan-English connection should be interpreted against this larger network of European-Islamic exchange.

Huib ZUIDERVAART | Huygens Institute for the History of the Netherlands, Netherlands

The astronomical observatory of Johan Maurits Mohr in Indonesia (1768-1775) and its relevance to the Amsterdam 'Felix Meritis' observatory (1787-1889)

In June 1761, reverend Johan Maurits Mohr in colonial Batavia (nowadays Jakarta, Indonesia) participated in the local observation of

the famous Venus transit. This event stimulated him to erect in 1768 an astronomical observatory on top of his impressive European-styled mansion, which site was equipped with state-of-the-art astronomical instruments, bought in England and the Netherlands. Here Mohr observed the Venus transit of 1769 and several other astronomical events. After his death, in 1775, the instruments were shipped to the Netherlands for repair. But after their arrival, they were only stored to an attic, left unnoticed for more than a decade. In 1787, after the Amsterdam learned Society 'Felix Meritis' had announced plans to erect a 'Temple of Enlightenment' for the housing of their activities, the almost forgotten instruments were offered to the board of this society. This opportunity led to alterations in the original scheme of the building, which already concerned the most ambitious attempt in the Dutch Republic for the integration of activities regarding literature, music, the arts, commerce and the natural sciences. So, on top of this new building, which was completed in 1790, a two-storey astronomical observatory with a platform was constructed, furnished with Mohr's former instruments. They were complemented by some new instruments, bought in France and the Netherlands. In my presentation I will give an outline of both observatories and their importance for Dutch astronomy. How were they designed? Which instruments were used and with which ambition? What do we know about the transport between Europe and Asia in 1768, and back in 1775? And finally, what was the fate of these instruments after the closure of the 'Felix Meritis' Observatory in 1889?

Sara SCHECHNER | Harvard University, United States

Trading in time: European pocket sundials designed for colonial use in American territories

In the 17th and 18th centuries, instrument makers in European cities made many types of portable sundials suitable for use by individuals at different latitudes. To aid the traveler, many sundials came with a gazetteer listing cities and their latitudes where the user might find himself – typically cities in the region where the dial was made or popular destinations throughout Europe. The gazetteers were pasted inside the lid of the sundial case, included as a broadsheet, or most frequently, engraved right on the surfaces of the sundial.

Rare among these portable dials are examples designed for use in colonial possessions and territories inhabited by the indigenous peoples in North and South America. This paper will closely examine some surviving pocket sundials with remarkable gazetteers listing remote forts, Native American tribal lands, pirates' lairs, and more.

Analysis of the material culture will shed light on the makers of the sundials, the people who used them, the range they covered, and the transmission of cartographic and ethnographic knowledge.

Ewa WYKA | Jagiellonian University, Poland

Contacts of Polish scholars with the English scientific community in the second half of the 18th century

Since the second half of the 18th century a remarkable revival in the fields of science and of culture was observed in Poland. It was a result of the election of the new king, Stanisław August, in 1764 and a system of reforms that were systematically introduced by the new government. More Polish scholars traveled to Europe to study modern science, to visit famous observatories or cabinets and to order scientific instruments. The contacts of Polish scholars with Jessie Ramsden, Peter Dollond, William Herschel, Holmes are confirmed by the documents and letters preserved in the Archives of Vilnius University and Cracow University. These documents will be presented as a Polish contribution to the dissemination of science in Europe in the Enlightenment.

W131-B. Trade and transfer of scientific instruments, part 2

Tue 23 July, 11:00–12:30 ▪ Schuster Rutherford

Chair: Paolo BRENNI | CNR, Fondazione Scienza e Tecnica, Switzerland

Alison MORRISON-LOW | National Museums Scotland, United Kingdom

Trade and transfer of instruments: early Scottish surveying instruments

Surveying instruments came on the scene comparatively late on in Scotland's history; thanks in part to a fairly stormy relationship with her larger island neighbour, a continuous indigenous instrument trade in instruments generally did not begin to flourish until the end of the eighteenth century. This paper will look at how the landscape was assessed – mainly for taxation purposes – after the 1745 Rebellion, and examine some surviving pieces to see if the engraved name reflects merely the point-of-sale, or perhaps a point of origin over the hills and far, far away ...

Steven TURNER | Smithsonian Institution, United States

Technology reinvented: establishing precision optical manufacture in the United States

Around 1845, Henry Fitz, Jr. became the first important American manufacturer of precision optics. In the nearly twenty years that he was in business he produced a series of increasingly large and impressive astronomical telescopes that were able to compete on every level with the finest European instruments. On five separate occasions he built what was, at the time, the largest telescope in the world; and during his working period he dominated the American telescope market.

But how was Fitz, who was trained as a locksmith and received no formal instruction in optics, able to do this? Like a handful of other Americans during this period, he was able to develop basic lens and mirror making skills through study and diligent practice. The basic techniques of lens grinding hadn't changed significantly since the 17th century and were accessible through books. Similarly, optical glass, abrasives and polishing materials could be ordered from European suppliers. It was perfectly possible for a determined individual to make a reasonably competent, moderately-sized telescope and perhaps even make a handful more to sell.

This is what Fitz did, but how was it possible for him to turn a hobby into a business and then - within just a few years - to compete successfully against the best precision optical manufacturers in Europe? Fitz's personal qualities of skill, hard-work, determination and thrift have traditionally been credited with making this possible, but a more historiographic approach would suggest that the particular economic, technical and social conditions of his time should also be considered. Surprisingly, re-examination of Fitz's correspondence during this period indicates that his brief involvement with early daguerreotype portraiture and his subsequent business relations with the New York photographic and scientific communities seem to have provided him with the opportunity to develop the optical skills and methods of production needed to found a thriving business - and to establish an American optical manufacturing industry.

Françoise LE GUET TULLY | Observatoire de la Côte d'Azur, France

French versus German astronomical instruments in a few nineteenth-century South American national observatories

In 1852 the Chilean government took over the temporary observatory that the United States Navy had installed in Santiago three years earlier in an attempt to determine the solar parallax by observing Venus and Mars. The German astronomer Carl Moesta was appointed director of this Chilean National Observatory. In 1871, the president of the young Argentine republic, Domingo F. Sarmiento, created a National Observatory in the university town of Córdoba at the request of the American astronomer Benjamin Gould, who was named director. The

same year, Emperor Pedro II of Brazil named the French astronomer Emmanuel Liais to head the Observatory of Rio de Janeiro. At about the same time a large meridian circle, ordered in Paris by the Peruvian government in the late 1860s, arrived in Lima. About ten years later, in 1882, the Governor of the Province of Buenos Aires, Dardo Rocha, decided that his new provincial capital, the utopian city of La Plata, would have an observatory – whose direction was entrusted to the French naval officer François Beuf.

We shall attempt to place the foundations of these South American establishments in their political and scientific contexts and give a description of their initial instrumentation. Then we shall try to assess the role of German science and the effects of the Franco-Prussian War of 1870 on the purchase of European instruments for these new observatories.

This presentation is based on work co-authored by Jean Davoigneau and Santiago Paolantonio.

KURODA Kotaro | Meijo University, Japan

The early history and development of the electron microscope in Japan

The development of electron microscope in the early 1930s in Germany had been watched with keen interest by scientists in Japan. In order to promote studies of electron microscopy and its applications more comprehensively, the need for a research committee was strongly promoted by Prof. S. Seto, Tokyo Imperial University and others. Thus a committee, the 37th Subcommittee of the 10th committee of the Japan Society for the Promotion of Science, was started May 1939 in Tokyo, gathering active researchers. Development of electron microscopes in Japan was started by members of this subcommittee.

Hitachi was one of the original members of the subcommittee. The first Hitachi transmission electron microscope (TEM) model HU-1 was developed in 1940. In 1942, Hitachi delivered the first Japanese commercialized TEM model HU-2 to Nagoya Imperial University just at the height of the Second World War. Although difficulties caused by the war became harder, research and development activities were continued. After the war was over, developments accelerated. In 1953, the first export of Hitachi TEM was accomplished and in 1958 the model HS-6 was awarded Grand Prix in the Brussels Exposition.

JEOL was founded in 1949, and TEM model JEM-1 was developed. JEM-5A, sold in 1953, adopted a two-stage illumination lens system and a three-stage imaging lens system, which enabled observation of not only the TEM image, but also the electron diffraction pattern. As a result, the usage has expanded not only to researchers in the field of biology and medicine, but also to those in the field of materials science. The JEM-5G, which was released in 1956, was exported to France for the first time. This was the first step of JEOL overseas expansion. With JEM-7, sold in 1964, electron beam deflectors and electromagnetic astigmatism correctors were built in, and since then, mechanical operation of alignment and astigmatism correctors were changed to electromagnetic operation, and thus TEM operation was greatly improved. Japanese TEMs achieved a significant increase in market share in the 1960s.

W131-C. The bigger, the better: physics and astronomy

Tue 23 July, 14:00–15:30 • Schuster Rutherford

Chair: Marcus GRANATO | Museum of Astronomy and Related Sciences, Brazil

Dominique BERNARD | Université de Rennes 1, France
Jean-François LOUDE | École polytechnique fédérale de Lausanne, Switzerland

Laboratory electromagnets from Michael Faraday to Pierre Weiss

Until the 1970s, when superconducting magnets became common, iron-cored electromagnets were normally used to produce steady magnetic fields of high intensity. We will follow the evolution of laboratory electromagnets, used to investigate the magnetic, magneto-optical or atomic properties of materials, from Michael Faraday to Pierre Weiss and his followers. Other forgotten models of electromagnets (du Bois, ...) will be mentioned. This evolution culminated with the construction of the large Leiden electromagnet and the giant ones at Meudon-Bellevue (near Paris) and Uppsala. This paper will focus on the electromagnets designed by the French physicist Pierre Weiss (1865-1940), who made pioneering studies of ferromagnetic materials, giving his name to the uniformly magnetized "Weiss domains". From 1895 to 1899, he was "Maître de Conférences" at the University of Rennes (France). While in Rennes, he published in 1898 an article describing an electromagnet based on the novel rectangular-framed geometry already used by Rühmkorff in 1849, with two coaxial cylindrical coils around the poles. Following an idea by Ewing, he added a third coil around the yoke. A prototype has been rediscovered in the collections of scientific instruments at the University of Rennes 1. Later on, this type of magnet was available from several makers. One of them is exhibited in Florence. In 1902, Weiss became professor and director of the Physics Laboratory at the ETH in Zurich. In 1907, he published the design of the first truly modern electromagnet. The electromagnet, built by Maschinenfabrik Oerlikon and installed at ETH-Zurich, has been lost. An improved one, dated 1914, made for Jean Becquerel at the Muséum (Paris), can still be seen at Meudon. The largest one following this pattern (14 t) was installed in Leiden around 1930 and is now exhibited at the Boerhaave Museum. In 1918, after the return of Alsace to France, Pierre Weiss went to the University of Strasbourg where he founded and directed for 20 years a laboratory dedicated to magnetism studies. He worked with the French physicist Aimé Cotton on the project of the giant electromagnet (120 t) of Bellevue. A whole range of laboratory electromagnets, following the pattern proposed in 1907, and including improvements especially in the cooling system, were built by well-known manufacturers: Maschinenfabrik Oerlikon-Zurich, SIP-Genève, Siemens & Halske, Carpentier, Ducretet, etc. Small ones are still in production now.

Alison BOYLE | Science Museum, London, United Kingdom

Colliding knowledge at CERN: inside the world's largest scientific instrument

What constitutes a "scientific instrument" has changed over time (see Liba Taub's survey in *Isis*, December 2011), and in *Image and Logic* (1997) Peter Galison argued that the instrumentation of 20th century microphysics should be understood as a quasi-autonomous subculture, interplaying with experimentation and theory. While CERN's Large Hadron Collider is often described as "the world's largest scientific instrument", it can also be viewed as a complex of many individual instruments, which were developed and built in different academic and commercial institutions around the world (for first-hand accounts of the process, see Lyndon Evans, *The Large Hadron Collider: a Marvel of Technology*, 2009). The design, construction and operation of the LHC provides a rich array of opportunities to study international trade in instruments and transfer of knowledge in the late 20th and early 21st centuries.

This talk will 'zoom in' on some of the instruments that make up small parts of the whole LHC, exploring their development and integration into the wider system at CERN, and examine how the people who have designed, built and used them have blurred disciplinary boundaries during long careers in accelerator and detector physics.

I will also provide a brief preview of the Science Museum's forthcoming exhibition on the LHC, which aims to go beyond traditional museum expositions of particle physics focussing solely on scientific principles,

and explore the practices of working on the world's largest scientific project.

Tania DOMINICI | Laboratório Nacional de Astrofísica (MCTI/LNA), Brazil

Pico dos Dias Observatory and its instrumentation: witnesses of astronomical revolutions in the last four decades

First light for Pico dos Dias Observatory (OPD) occurred on April 22, 1980. The Observatory is located between the cities of Brazópolis and Piranguçu (Minas Gerais, Brazil), at an altitude of 1864 m. It is operated by the National Laboratory of Astrophysics (LNA) and it is home to the largest optical telescope in Brazil: the 1.6 m Perkin-Elmer with equatorial mount. OPD was crucial for the development of Brazilian astronomy. No more than a few PhDs existed in Brazil at the time of the project (in the 1960s), construction and beginning of its operations. The availability of the Observatory encouraged a significant increase in post-graduate studies; today, there are ca. 300 PhDs in Brazil. Instrumentation has also evolved from photographic plates and photomultipliers to the newest generation of semiconductor-based detectors. Therefore, OPD was contemporaneous of the revolution in the generation of astronomical data along the 20th century: from the complex register of images and spectra in the photographic plates to the production of gigabytes of data in a single night. Since 2010, we have been working on the documentation and preservation of the historical materials of the Observatory. The collection includes detectors, microdensitometers, fotometers, filters, meteorological instruments as well as photographic plates and other astronomical data registers. In this work we will present the organization of this collection aimed at creating a virtual museum, which will provide broad public access to this important chapter of scientific development in Brazil.

This presentation is based on work co-authored by Cláudia Penha Santos and Katia Bello.

W131-D. Understanding instruments of physics through re-use and replication

Tue 23 July, 16:00–17:30 • Schuster Rutherford

Chair: Hans HOOIJMAIJERS | Museum Boerhaave, Netherlands

Wolfgang ENGELS | Carl von Ossietzky Universität Oldenburg, Germany

Michael KOREY | Staatliche Kunstsammlungen Dresden, Germany

"So as not to tear the arm and leg of the experimenter in two": reflections on the replication of a royal air pump

The large air pump with inclined cylinder by Jacob Leupold of Leipzig (1709) numbers among the treasures of the Mathematisch-Physikalischer Salon (MPS) in Dresden. Purchased by August the Strong of Saxony, it has survived fairly intact over three centuries, though much of its accompanying apparatus has been lost. The pump and its use are documented in several of Leupold's treatises, in the original inventory of the MPS (1730-32), and in experiments performed by Christian Wolff.

As part of its re-conceptualization, the MPS has commissioned a detailed replica of the pump and a reconstruction of some of its lost apparatus for use in public demonstrations within the museum. This paper documents a few of the many challenges encountered during the analysis and replication of the pump as well as in the resurrection of some of the (not always danger-free) experiments once performed with

it. It highlights certain discrepancies found between the material instrument and the written sources and also identifies some modifications made to Leupold's original design. Finally, it offers a glimpse at the lessons learned during the first public demonstrations with the replicated instrument.

This presentation is based on work co-authored by Andreas Holfert.

Timo ENGELS | Flensburg University, Germany

Circle of invention and rejection: using liquid columns for density measurement

From the 18th up to the end of the 19th century, various instruments designed for measuring the densities of liquids struggled to become accepted laboratory apparatus. Of those, several instruments use the principle of comparing the heights of liquid columns, raised by the same pressure difference. Proposals for such instruments can be found all over Europe and North America, as well as their widespread and immediate rejection by the scientific community they were meant for. The main (projected) fields of application were chemical, pharmaceutical and physical laboratories. As widespread as the idea might have been, its continued failure seems not to have been as well known. In my talk I will explain the different instruments of this type, starting with a device described by Pieter van Musschenbroek in his "Elementa Physicae" in 1747 and present not only a genealogy of them, but also address their failure. For this analysis the written sources were carefully examined. Moreover, two instruments were reconstructed according to all available sources. The first one is the earliest known instrument of this type, as depicted by Musschenbroek. The second one is the so-called Litrameter, constructed by the well-known chemist Robert Hare in 1826. The practice with these two instruments is compared to the written arguments and criticism. This survey, as a microhistoric analysis, sheds light on processes that lead to the rejection of instruments, using classic analysis of written sources and the opportunities of experimental history.

Martin PANUSCH | Universität Flensburg, Germany

Working with Millikan's vessel

Millikan's Oil Drop experiment served as an argument for the atomistic theory of electricity. However historians of science have raised questions concerning Millikan's methods and his results. In my ongoing project I am analyzing material and procedural aspects of this experiment with the replication method. In doing so I first analyzed published and unpublished sources as well as material remains related to this experiment. First results of my analysis, such as the genealogy of oil drop apparatus reflecting the development of the experiment and some technical and material aspects, were lately published in the Bulletin of the Scientific Instrument Society. Recently we reconstructed an oil drop apparatus that is as close as possible to the one Millikan used in 1913. After some research concerning the peripheral devices we are now able to analyze the practice with our oil drop apparatus. In my talk I will present more technical and material aspects of the apparatus and the experiment that became evident in the process of the reconstruction. Moreover I will report on my experiences with the apparatus and relate them to Millikan's accounts. In doing so I will add some details toward the understanding of experimental practices in the Ryerson Laboratory in Chicago before World War I.

Sebastian KORFF | University of Flensburg, Germany

Reading Geiger's counter

The Geiger-Müller counter is nowadays best known for its characteristic clicking noise and its function in radiation protection. But its genesis is – for several reasons – fairly unclear. It was developed by Walter Müller under the supervision of his former thesis adviser Hans Geiger in Kiel in spring 1928. The new so-called "Elektronenzählrohr" surpassed its predecessors because of its ability to detect less intense γ -radiation and cosmic rays. In the early 1930s the instrument that was soon baptized Geiger-Müller Counter quickly became canonical in the field of

radioactivity and early cosmic ray research. It achieved this status despite the fact that the knowledge about its working, its construction and its handling was not transferred to a broader audience. Because of inter alia a highly restrictive secrecy policy by Geiger and Müller, only a few textual sources exist. As a result, the historical research field is difficult to grasp. However, an analysis with the replication method seemed possible. During the research I found an artifact of an early counter tube in the Smithsonian Institution. Walter Müller himself donated it in the 1970s together with five related notebooks. But the artifact's analysis provided more questions than clarifications on the construction process. My paper will develop the genesis of the counter based on the three methods: the analysis of the available textual sources, the construction of the replica and the analysis of the process, and the reading of the artifact of an early counter as well as its historical classification. In doing so, I will discuss the evolution of the device as well as some aspects of the skills that are required in making and operating this device.

W131-E. The ravages of time

Wed 24 July, 11:00–12:30 ▪ Schuster Rutherford

Chair: Michael KOREY | Staatliche Kunstsammlungen Dresden, Germany

Marisa MONTEIRO | Museu de Ciência da Universidade do Porto, Portugal

Time-related instruments in a science collection

The Museum of Science of the University of Porto, founded in 1996, has been collecting scientific instruments and teaching objects which once belonged to the institutions that historically preceded this university, within a timespan of two hundred and fifty years, namely, the Royal Academy of Navigation and Commerce (1803-1837) and the Polytechnic Academy (1837-1911). A few examples of instruments designed to keep, measure and record time have been picked out of the collection, and framed in the context of the purpose each one of those institutions was serving. As it is, an astronomical regulator, bought from John Roger Arnold, London, in the early days of the Royal Academy of Navigation and Commerce, is believed to have been used as an astronomical time standard, to set on time the marine chronometers of the training pilots, for the accurate determination of longitude through the by then well-established chronometric method. A clock that makes an electric contact every second, by dipping a platinum wire in a mercury filled cup, designed to superimpose a time signal on to the continuous recording of some physical quantity, stands out as an example of other similarly oriented instruments purchased in the early 20th century, when teaching physics at the Polytechnic Academy came to rely less on demonstrations and more on quantitative experiments. Also noteworthy is a photographic recording system that has been devised by the physicist Mascart in the early 1880s and widely used in French observatories, together with Lord Kelvin's quadrant electrometer, to study terrestrial magnetism and atmospheric electricity. The annexation of a Meteorological Observatory by the Polytechnic Academy, in 1901, has contributed this system to the present collection. The appearance of electronics and electronic instrumentation and, consequently, of non-mechanical means to measure time, is represented in the collection of the Museum by the cathode ray oscillograph acquired from the Du Mont Laboratories by the Physics Laboratory of the Faculty of Science in 1946.

This presentation is based on work co-authored by Luís Bernardo.

Giorgio STRANO | Museo Galileo: Istituto e Museo di Storia della Scienza, Italy

From "history of astronomy" to "experimental history of astronomy" and beyond: the modern use of ancient meridian lines

The adjective “experimental” appears odd when applied to astronomy, which is a discipline based on observations at a distance. Nevertheless, during the last 40 years the traditional “History of astronomy” generated two additional branches: the so-called “Experimental history of astronomy” and “Experimental historical astronomy”. The first branch aims at verifying old astronomical data and theories by performing new observations. The second branch has as its purpose the elaboration or the confirmation of new astronomical theories via the examination of ancient observational records. In this paper, beside a brief examination of both branches, I will introduce two examples based upon the repetition of observations with ancient monumental meridian lines in the city of Florence, Italy: the one in the church of Santa Maria del Fiore, dating back to epoch of Paolo dal Pozzo Toscanelli, and the one in the Storks’ Room of the Torrino of the Specola, built in the fourth quarter of the eighteenth century. In addition to singling out the sound observational bases of the (optical) theories of Egnatio Danti, and providing evidence which confirm modern planetary phenomena, as the variation of the obliquity of the ecliptic, such large meridian lines are also useful in ascertaining the stability and the structural alterations of the historical buildings.

Hans HOOIJMAIJERS | Museum Boerhaave, Netherlands

Restoration of the oldest planetarium (orrery): the Leiden Sphaera

In this paper I will deliver the story of a planetarium conceived by a wealthy burgomaster of Rotterdam in the seventeenth century and now on display in the Museum Boerhaave. I will firstly sketch the origins and life-story of this large orrery, describing how it stayed unknown during its early years and only became famous after it was transferred to Leiden. It was there that the instrument was given a name: The Leiden Sphaera.

In the second part of my talk I will describe the restoration of the planetarium carried out by the Boerhaave staff. I will discuss not only the details of this work, but also some of the new information that appeared during the dismantling of the object.

Victor PEREZ | Universidad de Valladolid, Spain

The mechanical clock and science in the late Middle Ages

The mechanical clock appeared in Europe in late thirteenth century as a new invention. The idea that links it with the development of the urban society and a new need for time telling in cities has been widely extended in historiography, but nowadays its invention and spread is considered a complex phenomenon in which many factors are involved. Science is one of them, but it takes an important role from the sixteenth and seventeenth centuries onwards. This paper attempts to explain the relation of this device with science before the so-called scientific revolution in the early modern period. The mechanical clock in the Middle Ages was used as a prestige object and this was maybe the most important factor for its spread throughout Europe. It was also a practical instrument not only for time telling but also for representing the heavens and the universe. This could be the purpose of its invention. Academics in the thirteenth century were interested in the construction of a self-moving machine to drive a model of the universe. Roger Bacon expressed this desire in a famous letter dated in 1271, which is considered the terminus post quem for the invention of the mechanical clock. The clepsydra had been playing this role since the Antiquity, but the mechanical clock replaced it immediately and the clepsydra virtually disappeared in Europe. Some of the oldest known clocks were astronomical and were designed by academics or by people interested in science like Giovanni Dondi or Richard of Wallingford. Not only academics were interested in the mechanical clock as a model of the Universe, but also people from the highest social strata. Peter IV of Aragon in the fourteenth century owned some clocks, astrolabes and other instruments and he used them as diplomatical gifts. We can find more examples in Spanish medieval Royal Courts. The mechanical clock as an instrument for time telling made people time conscious and laid

the foundations of a new time concept as an abstract and an individual entity. It was a substantial but a long-term change in Europe, because it became a widely spread accessory and became familiar to a wide social range of people.

W131-F. Instruments for exploration

Wed 24 July, 14:00–15:30 ▪ Schuster Rutherford

Chair: Alison MORRISON-LOW | National Museums Scotland, United Kingdom

Terje BRUNDTLAND | University of Tromsø, Norway

The life of instruments

In 1902, the Norwegian Professor Kristian Birkeland organized a large expedition to the Arctic for studies of aurora borealis, terrestrial magnetism and cirrus clouds. He established four stations at different locations: in Northern Norway, Novaja Semlja, Iceland, and Spitsbergen, all equipped with a similar set of instruments.

A description of stations and the instruments will be given, discussing how not only the instruments themselves, but also how external equipment, buildings, camp-facilities, as well as the manual work performed by the expedition members all contributed to produce the final results: magnetograms that Birkeland later used to draw his conclusions.

Some of Birkeland’s instruments had been used by earlier expeditions, and became also used by later scientific travellers. It becomes clear, that in this period, instruments were regarded as valuables and investments, which kept its worth and importance during transfer between periods, professors, institutions, and fields of applications.

Gudrun WOLFSCHMIDT | University of Hamburg, Germany

Time balls in the German Empire and timekeeping for navigation

In port cities accurate timekeeping always played an important role for navigation and for the exact determination of the longitude at sea. The first time ball was erected in Greenwich observatory in 1833. Around 200 time balls were built worldwide, and about 60 still exist, many in English-speaking countries. In the German Empire time balls were erected in cities along the coast of the North Sea and the Baltic, the first in the Imperial Naval Observatory in Wilhelmshaven (observatory 1874-1905, port 1905), then in Cuxhaven (column 1875-1929/1934), Bremerhaven (time ball column 1876-1928/1948, port office 1895, lighthouse), Bremen (port office 1895), Emden (port 1911), Kiel (observatory 1884, Imperial Wharf 1886, artillery warehouse 1908), Swinemünde (now Swinoujście, Poland, column 1879), Stettin (Szczecin, government building 1908), Danzig-Neufahrwasser (Gdansk Nowy Port, Poland, pilot tower 1876-1894, lighthouse 1894-1929, 2008) and Qingdao (Tsingtau, observatory 1898, time ball 1909). The time ball in Hamburg on the top of the Imperial Warehouse, made by Carl Bamberg of Berlin in 1876, had a complicated construction. After a fire it was rebuilt in 1893 (diameter of the time ball 1.5m, 53m high); it was in use until 1934 and demolished in 1967. The time was determined by observing meridian transits of stars in Hamburg Observatory with the Repsold meridian circle and transmitted to the time balls, first through an electric cable, then in Hamburg already since 1910 by radio technology (Norddeich Radio Station). In 1919 a time service was started in the German Hydrographical Office (Deutsche Seewarte) in Hamburg; the Cuxhaven and Bremerhaven time balls were taken over and regulated by this office beginning in 1929 and were thus no longer managed by the local observatory. A very detailed model of the Hamburg time ball (1:10) was made in 2011.

Lina HAKIM | London Consortium, United Kingdom

Instruments as playthings: an alternative methodology

"The way in which yesterday’s science so often becomes today’s recreation does not make it any less scientific. Indeed, much scientific,

and other, knowledge is absorbed consciously or unconsciously through play." [Gerard L'E. Turner, Presidential Address: 'Scientific Toys', *British Journal for the History of Science*, Vol. 20 (1987), pp. 377-398, here p.384]. In his 1987 presidential address about 'Scientific Toys', Gerard L'Estrange Turner wrote of the importance of 'Homo Ludens' when "considering how human beings acquire knowledge" (Turner, 1987, p. 377). Picking up on his study of philosophical instruments that passed into recreational use in the 19th century and became toys in the 20th century, this paper suggests that thinking of scientific instruments as playthings opens them up to the kind of research that bridges academic and museological concerns. I begin by arguing that the attention to technology and materials during play leads a consideration of scientific instruments into the realm of playthings [cf. Walter Benjamin, 'Toys and Play: Marginal Notes on a Monumental Work', in eds. Michael W. Jennings, Marcus Bullock, Howard Eiland and Gary Smith, trans. Rodney Livingston et al. *Walter Benjamin: Selected Writings*, Vol. 2, Part 2, 1927–1930 (Cambridge & London, 2005), pp.117-21]. I then explain how regarding instruments as playthings allows for a phenomenological/ecological approach to artefacts that takes into account their varying roles and meanings. This will allow me to introduce the notion of 'historical affordance' to relate the evolution in what an instrument offers to perception and understanding. After fleshing out this methodology, I sketch briefly its application in three case studies: the gyroscope, the radiometer and the string surface model. These will demonstrate how thinking of the artefacts as playthings offers scope for 'tuning in' to the instruments whose instability and mobility are put forward.

W131-G. Instruments and public health

Wed 24 July, 16:00–17:30 • Schuster Rutherford

Chair: Richard KREMER | Dartmouth College, United States

Dana FREIBURGER | University of Wisconsin-Madison, United States

Sweater Girl Chickens - The rise and fall of the Chicken Breast Meter

In the late 1940s American agriculturalists developed the Chicken Breast Meter, a new tool that determined the breast angle of meat-type chickens. In contrast to measurements associated with egg laying, this instrument provided data useful to the breeding of meatier chickens, particularly broad-breasted birds considered attractive by the post-war American consumer.

Several versions of this scientific instrument came into being, including one developed by West Virginia poultry man John E. Weidlich, an accomplished chicken breeder whose "Sweater Girl Chickens" earned national honors in the 1948 Chicken-of-Tomorrow contest. Inexpensive and easy to use, this instrument added a new dimension to breeding experiments besides the weight of a fully grown and ready-to-harvest bird. With the aid of this new instrument, "breast angle" began to appear as another column of scientific data in published articles and reports.

In my talk, I describe the factors that led to this instrument's development and explain why it fell from favor within a few decades. My paper highlights scientific knowledge at work and the trade of instruments; it also discusses the amateur/scientist divide, government support of science, and popularization of science with the public. In explaining how chicken producers turned to science in pursuit of a "better bird," I will show food-related scientific instrumentation as a realm worthy of further exploration.

Ad MAAS | Museum Boerhaave, Netherlands

Scientific instruments for the public's health: the monitors of the Dutch national measuring network for air pollution in the 1970s and 1980s

Recently, Museum Boerhaave acquired a set of air pollution monitors, which were used in the 1970s and 1980s in the national measuring network for air pollution, which covered the whole area of the Netherlands. The monitors, made by Philips, show a notable technical evolution. Whereas the first types worked according to chemical detection principles, the subsequent generations consisted of electronic detection cells. Yet, what make the instruments particularly interesting is that they can be regarded as artefacts that reflect the large social concern with air pollution in the 1970s and 1980s (especially acid rain). From the point of view of the history of scientific instruments, the monitors make an interesting case because they belong to a category of instruments that have not received much attention so far: scientific instruments devised specifically to protect human beings.

Robert D. Hicks | College of Physicians of Philadelphia, United States

S. Weir Mitchell and Civil War shock therapy

The years from 2011 to 2015 mark the sesquicentennial of the American Civil War. In 2013, The College of Physicians of Philadelphia opens a permanent exhibit on the war's medical dimension, *Broken Bodies, Suffering Spirits: Injury, Death, and Healing in Civil War Philadelphia*. Unlike most exhibits of Civil War medicine that explore the industrial scale of warfare and the heroic treatments afforded mass casualties of disease and wounds, *Broken Bodies* presents a history of the body. The most sophisticated and unpredictable technology applied to the soldier's body was electrotherapy at America's first neurological hospital, Turner's Lane in Philadelphia. The pioneering work at Turner's Lane conducted by physicians S. Weir Mitchell, William W. Keen, and George R. Morehouse in studying diseases and wounds of the nerves will receive particular emphasis in the exhibit. The regimen for treatment of nerve injuries was comprehensive and employed the first machines for diagnosis and therapy in American medicine, "Faradisation" and "Galvanisation" devices. Mitchell published two treatises on his wartime treatments in which electrical devices feature in case histories as innovative and indispensable devices. They were necessary in treating severe and unprecedented nerve injuries caused by war wounds, devices he described as "the most overrated and underrated of all the medical armaments." The bodily reactions obtained through the application of electricity necessitated the articulation of electrical qualities of the human body—"electro-muscular sensibility" and "electric contractility." This presentation explores the links between experimental electrical technology, unprecedented therapeutic intervention in bodily functions, and the production of physiological knowledge. These domains are discussed with a view of their interpretation in a museum exhibit.

Márcia REGINA BARROS DA SILVA | Universidade de São Paulo, Brazil

Cardiac implants: valves, pace-makers and Brazilian scientific cinema

The aim of this paper is to discuss the themes of objectivity and neutrality as present in scientific movies of medical content produced by Brazilian documentarist Benedito Junqueira Duarte. The production of images of a specific practice – the first experimental surgeries for implantation of cardiac valves and pace-makers – carried on during the early 1960s, were used for the presentation of new medical instruments, materials, equipments and procedures related to the field of heart surgery and transplantation. In this process, the representation of instruments and materials helped to build a language characteristic of the film-maker's production, and at the same time promoted the construction of a given scientific memory, associated with certain institutions and characters of Brazilian medicine. As pointed out by Bruno Latour and Karin Knorr-Cetina, it is interesting to evaluate the

observation of nature as an activity mediated by several elements that "fixate" a given relation, which, after a long process of "translation", may circulate freely and solidify as a verifiable, consistent fact. When its path is traced out, this circulation reveals itself to be based upon canons in which the relations of truth, objectivity and neutrality are the results, and not the starting-points, of scientific practice. Two movies of Benedito Junqueira Duarte are highlighted here: "Marca-passo implantável" and "Válvula Cardíaca", both from 1968, produced under the scientific consultancy of cardiac surgeon Adib Jatene (regarded today by the Brazilian public as a pioneer developer of heart-surgery instruments). Starting from these movies I intend to discuss some points related to the notions of "being true to the facts and phenomena of science", and the presence of cinematic language as the locus of action of a scientific discourse based on technological apparatus, instruments and experimentation. In this case, such relations conferred to what is specifically cinematic the function of producing truth-proofs about the "natural" world, here represented by the human body.

W131-H. Innovative optical instruments

Thu 25 July, 09:00–10:30 • Schuster Rutherford

Chair: **Kenneth LAUNIE** | Zink Imaging, United States

Neil BROWN | Independent scholar, United Kingdom

Diffraction gratings in Europe in the nineteenth century: a neglected history

Diffraction gratings are primarily associated with Henry Rowland of Johns Hopkins University from the early 1880s onwards, and rightly so, but there was an earlier phase of diffraction grating production and use in Europe during the 1860s and 1870s. After Joseph von Fraunhofer's seminal investigation of diffraction gratings around 1820 little happened for several decades until Anders Ångström used diffraction gratings made by a little known instrument maker called Friedrich Nobert to measure the wavelengths of the Fraunhofer lines in the solar spectrum. Ångström's measurements became an authoritative standard, but there were also others whose work has received little or no attention who made wavelength measurements using diffraction gratings, almost all of which were made by Nobert.

In this paper I will examine firstly the technique used by Nobert and the extent of his production of diffraction gratings, and secondly the work with diffraction gratings of researchers such as Ångström, in Uppsala, Van der Willigen, in Haarlem, Ditscheiner, in Vienna, Mascart, in Paris.

Beto PIMENTEL | Universidade Federal do Rio de Janeiro (UFRJ), Brazil

Young, Arago, Fresnel and the compensating plate

The compensating plate was at the heart of the first interferometers developed at the beginning of the nineteenth century. In essence, it is a humble glass plate that could be pivoted around an axis, changing the angle of incidence of the incoming beam of light onto it. The apparent simplicity of the contraption hides its ingenuity: by turning the compensating plate around, the experimenter could increase or decrease the length of the path taken by light while moving within the glass, thus delaying it more or less on each arm of the interferometer, until conditions for interference could occur again. Specifically, the technique developed by the first interferometrists consisted of bringing the central maximum of interference back to its original position and then measuring the angle along which the compensating plate was turned, thus allowing for the calculation of whatever quantity was varied within the system. This presentation aims at showing both the origins of the idea of the compensating plate and the uses made of it in the beginning of interferometry, displaying how the success achieved by these pioneering instruments was instrumental not only for the development of

the next generations of interferometers, but also for the establishment of the undulatory theory of light itself. These instruments also epitomize a transition period in the history of instrument making in which artisans and academicians worked closely together in the development of their measuring instruments.

James CAPLAN | Université d'Aix-Marseille, France

Early development of photographic techniques for measuring stellar positions

I have been researching the rise and fall of instruments for the measurement of astronomical photographs. Here I consider those instruments used for astrometry, and their related data reduction procedures.

Known as 'measuring machines', these devices for measuring positions on photographic plates were originally developed mainly for the great international Carte du Ciel/Astrographic Catalogue project, established in 1887. Through much of the 20th century, use of such machines and the methods developed for the Catalogue were part of the standard 'tool kit' of most astronomers, much as computers are today.

Parallel to the instrumental development, during the project's first decade astronomers debated practical methods for converting positions on photographic plates to coordinates in the sky. The original plan had been to make only an atlas, and astronomers were surprisingly unprepared for determining accurate angles in the sky for the Catalogue. This did not stop them from finalizing the camera (astrograph) parameters before understanding the consequences for the determination of accurate coordinates.

The Carte du Ciel astronomers were worried about possible emulsion creep (which was in fact negligible) and for this reason decided to expose a 'réseau' of lines onto each plate along with the image of the sky. Not until a few years later did they mention the more problematic 'optical distortion'. The field curvature of the astrographs was only noticed years later. (The Seidel formalism for aberrations, developed in the 1850s, seems to have been unknown to them.)

The basic calculation technique ultimately used for the Astrographic Catalogue - 'standard' ('tangential') coordinates - was proposed only in 1893, six years after the beginning of the project, by H.H. Turner of Oxford. Without this technique the reductions of the Astrographic Catalogue would have been impossible without electronic computers. Today these instruments and techniques are largely forgotten. Many machines have been discarded. Unlike old telescopes, they do not interest the public. But these tools were a central part of the mid-twentieth-century observatory, often more than the telescopes themselves, which had already largely migrated away from urban areas and would soon be built at high altitude. The lives of many astronomers and their collaborators, working in university observatories in towns and on campuses, often revolved around these forgotten devices.

Jan Waling HUISMAN | University of Groningen, Netherlands

Nobel Prize or eternal fame? Caught up by time

One of the best things that can happen to a university is to have a Nobel Prize laureate among its staff or alumni. In the case of the University of Groningen we are happy to have a winner. In 1953 Frits Zernike was awarded the Nobel Prize for physics, because of his invention of the phase-contrast microscope. But the work of Zernike involved more than just this. Much of his work has influenced theoretical physics, but he was also a keen DIY-er and built most of his inventions by himself. I will present some of his more unknown inventions, which had, or did not have, some influence in the world of physics, but are most caught up by time.

W131-J. Mathematical instruments for royalty and the rich

Thu 25 July, 11:00–12:30 • Schuster Rutherford

Chair: Stephen JOHNSTON | University of Oxford, United Kingdom

Silke ACKERMANN | Baltic College University of Applied Sciences, Germany

Measuring distances, measuring time: Peter Jachenow (d. 1601), a Mecklenburg instrument-maker and the courts of Europe

Like many of his peers in the 16th century, Duke Ulrich of Mecklenburg-Güstrow in North-Eastern Germany was a great patron of the arts and sciences. Instruments, clocks and automata were amongst his most-priced possessions.

Among the artisans working at his court features Peter Jachenow. The Schwerin clockmaker and instrument-maker was especially valued for his odometers, which were popular not only with Duke Ulrich, but also with King Frederick II of Denmark and Tycho Brahe, with whom the Duke was in close contact. From about 1588 Jachenow became a frequent visitor of Tycho's, whose carriage he fitted with an odometer that recorded distances to the striking of bells. Tycho was enchanted with his acquisition and recommended Jachenow to Thaddaeus Hagecius, astronomer and doctor to Emperor Rudolf II.

This paper will attempt to shed some light on this now little known instrument maker who was at his time highly regarded at the courts of Europe.

Louise DEVOY | British Museum, United Kingdom

A English man born in ye north - Humfrey Cole revisited

Humfrey Cole, the first English-born instrument maker in Elizabethan England (died. 1591) and his spectacular mathematical instruments were thought to have been discussed exhaustively by Turner (2000) and Ackermann (1998 and 2004).

The situation changed in 2009 when an extremely rare astrolabic quadrant, discovered during an archeological rescue excavation in Canterbury, narrowly escaped export and was bought at huge expense for the British Museum. The resulting publicity from this discovery led to the acquisition of another, equally spectacular instrument: a hitherto unrecorded horary quadrant signed by Humfrey Cole and dated 1573.

This paper will discuss the acquisition and features of Humfrey Cole's newly rediscovered quadrant and place the instrument in a larger historical context.

Michael KOREY | Staatliche Kunstsammlungen Dresden, Germany

Samuel GESSNER | Centre for the History of Science and Technology (CIUHCT), Portugal

Pointing at the points: multipoint universal compass instruments and shared mathematical culture in the 16th century

Multipurpose compass instruments became fashionable all over Europe during the second half of the 16th century. One particular variant featured multiple points and is most notably associated with the name of the Italian practitioner Fabrizio Mordente. Although recent scholarship (by F. Camerota, A. Meskens, and others) has done much to clarify the development of this special compass, it seems legitimate to ask whether we really understand how it and related instruments were supposed to work. Looking more closely at several inventions from the Iberian Peninsula and Southern Germany, this paper aims to make some new points about multiple compass points.

Irena KAMPA | University of Hamburg, Germany

Johannes Hevelius (1611-1687): the last ancient astronomer?

The invention of the telescope in the early 17th century is the onset of major developments of astronomical instruments, which remained basically unchanged since the times of antiquity. The topic of my paper is Johannes Hevelius, a skilled astronomer who lived and worked in the Baltic city of Gdansk (Danzig). He earned his living as a brewer and town councilor, but he devoted every free second to astronomy. Hevelius owned a private observatory on the roof of his house that he equipped with self-constructed astronomical instruments. His very first publication "Selenographia" (1647) was a big success and gained him acknowledgment in the scientific community. Its detailed prints of the lunar surface stayed unbeaten for nearly one hundred years. Beside his big repertoire of telescopes Hevelius also had various positional instruments like quadrants and sextants. He improved these devices and minimized their errors without ever changing their basic ancient design. In my paper I will present a few of his most sophisticated instruments that survived until today as beautiful engravings. I will describe their structure and usage and compare them to contemporary instruments. Nevertheless I will pursue the question if Hevelius could be called the last ancient astronomer.

W131-K. Heritage and collections

Fri 26 July, 09:00–10:30 • Schuster Rutherford

Chair: Robert D. Hicks | College of Physicians of Philadelphia, United States

Panagiotis LAZOS | National Hellenic Research Foundation, Greece

Scientific instruments of Phanar Greek Orthodox College (Fener Rum Erkek Lisesi) in Constantinople

The Phanar Greek Orthodox College (known in Greek as "Great School of the Nation") is an emblematic foundation of Constantinople with almost uninterrupted presence since 1454 and today is a high school for Orthodox students of Turkey. During the second half of 19th century the growth of the local Greek upper class led to a growth of educational institutions as well. As a result, the school was housed in 1883 in a new spacious building. Physics teaching was a priority for the local community and therefore the school possessed a well-equipped physics laboratory and a small observatory. Today the school operates with a small number of students, and the scientific instruments purchased until the seventies are not used anymore. Still they are very important not only scientifically but as signs of growth and prosperity of that era. Unfortunately, a great number of them are not in good condition and they need repair and restoration. Among the more than 130 scientific instruments of the school the most prominent are:

1. The refractor of the observatory
2. A quite complicated orrery
3. Coulomb's Torsion Balance Electrometer
4. Weinhold's apparatus for Foucault's experiment
5. Apparatus to show conservation of the plane of oscillation
6. Electromedical induction apparatus
7. Apparatus for showing the resultant of two directional forces
8. Melloni's apparatus
9. Helmholtz double siren
10. Helmholtz resonators
11. Carré induction machine

Flora PAPAROU | Independent scholar, Greece

Following the traces of science education in Greek schools and institutions of the North Aegean region from the beginning of the 19th century up to the 1920s

Amongst the showcases of the historic laboratory of the School of Chios, Jules Verne would have felt perfectly comfortable. Everything would be there: the Ruhmkorff coils, the volcanic rocks, the magic lamps, the

series of manometers, barometers and thermometers to record various atmospheric conditions; in other words, every piece of equipment that would be employed by his 19th-century explorers of nature. Taking this historic laboratory of Chios as our starting point and based on documents and objects related to equally important Greek educational institutions in Smyrna, Kydonies and Lesbos, we will reveal aspects of the teaching of science in the region of North Aegean from the beginning of the 19th century until the 1920s. Our historical journey will show that despite the fact that Hellenism did not participate actively in the Scientific Revolution of the 17th century, the European scientific spirit was introduced into the Greek world and became instrumental in the formation of the modern Greek cultural identity, thanks to the intellectual movement of the Greek Enlightenment. The Academy of Kydonies, the School of Chios and the Philological Gymnasium of Smyrna had a leading role in this process during the first decades of the 19th century. Their innovative curricula included the teaching of science, which was supported by the presence of excellent teachers, updated textbooks, scientific instruments and laboratories. Even though the outbreak of the Greek Revolution interrupted this educational process, the fame of the prerevolutionary schools and the intellectual development that had already been achieved resulted in a second period of educational growth. By the last decades of the 19th century and under the rule of the Ottoman Empire, schools and popular education institutions in the area of the North Aegean reached high European standards in the field of science education. This is related to the presence of scholars who constituted physical or intellectual links between the prerevolutionary period and the period of the late 19th and early 20th century. Through them the cause for Greek cultural identity, combined with the need to understand the modern European world, remained in the centre of intellectual and educational developments. In the cities of Asia Minor, where the land itself, full of Greek antiquities, fomented this pursuit, while the sense of progress and novelty led to significant educational achievements, the thread of Greek educational developments was permanently cut by 1922 by the “Asia Minor Catastrophe”.

Santiago VALLMITJANA | Universitat de Barcelona, Spain

Interrelations between scientific instruments and textbooks from the University of Barcelona Physics Faculty collection

The Faculty of Physics of the University of Barcelona has a significant collection of scientific instruments for teaching and research accumulated over more than one hundred and fifty years. It is a relatively recent collection, its recovery having been initiated in the Nineties.

In a similar and parallel way the Group of Libraries of the University of Barcelona has build up a huge patrimony of different documentation organised in a Catalogue with access to all the available documents in the libraries (books, magazines, multimedia and electronic resources, sound recordings, videos, etc.) and to an important old and rare books collection (incunabula, manuscripts, parchments, engravings and printed books from the 16th century up to 1900).

By looking at physics books between the years 1825 to 1925, an initial list of 359 books was compiled. After a work of filtering and selecting, a new, more useful list has been reduced to 15 items.

The main idea of this communication is to put the objects for teaching and research into a cultural context, which means examining the interrelations among instruments, images and textbooks of the time for educational purposes. The paper is centred on a selection of a few representative items (about 8 instruments) from different branches of physics (mechanics, acoustics, heat, optics, electricity, magnetism) that are typical in most collections of scientific instruments.

The evolution of the descriptive forms and the concepts on which the instruments have been designed in the different selected text-books is analysed. That is, we study the modulation of the transmission of the basic concepts through formal expressions of text and illustrations. The latter reveal interesting details that show an evolution and feedback to

better face the exposure of principle or concept and accuracy of measurements and results. It is also a more concrete analysis between certain devices and the books written by professors of the Faculty of Physics of the University of Barcelona in mid-nineteenth century and the first quarter of the twentieth century.

The conclusions could be of interest in order to increase our knowledge about the most common objects that were used in Europe for teaching and research in physics, especially in the academic context of our university.

W131-L. The big picture: documenting and displaying historic instruments and their makers

Fri 26 July, 11:00–12:30 • Schuster Rutherford

Chair: Giorgio STRANO | Museo Galileo: Istituto e Museo di Storia della Scienza, Italy

Paolo BRENNI | CNR, Fondazione Scienza e Tecnica, Switzerland

Historical scientific instruments at the universal exhibitions

The interest for historical scientific instruments as attractive collectibles and important artefacts for history of science and decorative arts is quite recent and began only around the beginning of the 19th century. The universal exhibitions of the second half of the century, which were spectacular showcases of the conquests of a triumphant bourgeoisie, were unique opportunities for presenting and displaying them. At the exhibitions historical instruments were shown as precious relics bearing witness to the work of famous scientists or the pretended intellectual primacy of a nation, as masterpieces of applied arts, as antiquarian curiosities, and as objects for illustrating scientific and technological progress. Instruments were lent by universities, astronomical observatories, scientific institutions as well as by private collectors. The presence of historical instruments at the “world’s fairs” largely contributed to increase their status and stimulated the foundation of permanent museums of science and technology.

Liliana M PINA | Universidade de Évora, Portugal

Ana CARDOSO DE MATOS | University of Évora - CIDEHUS, Portugal

The Communication Museum in Lisbon: contribution of its early collections to the history of telecommunications in nineteenth-century Portugal

Throughout the second half of the nineteenth century, important innovation experiences in telecommunications were presented at World Exhibitions in Europe. The circulation of knowledge, artefacts, ideas and professionals through technical publications and journals, travellers and specialised meetings and congresses facilitated increasingly widespread dissemination about these developments from country to country. Moreover, this circulation promoted the creation of several museums of science and technology. In Portugal, one of the earliest such museums is the Communication Museum, created in 1877 (Museu Postal), under the postal governmental authority (Direcção Geral dos Correios). The Museum still exists today and its disciplinary scope has been enlarged. However, when it was created technological development was already significant and it aimed at preserving the memory of telecommunications through artefacts and documentation associated with Portuguese experts in the field. This paper presents an ongoing research into the Museum’s early collection, particularly telegraphs and telephones, in order to understand its contribution to the history of telecommunications in Portugal and Europe. The methodology is material culture-oriented. Discussion will focus on artefacts that considerably materialise European

networks and innovation transfer, namely the telegraphs and telephones signed by Cristiano Augusto Bramão (1840-1881) and Maximiliano Augusto Herrmann (1838-1913), both displayed in World Exhibitions.

Gloria CLIFTON | Royal Museums Greenwich, United Kingdom

Building a database and directory of British scientific instrument makers 1851-1914 and its use in tracing links between firms involved in the trade.

Building on the work published in 1995 in the *Directory of British Scientific Instrument Makers c. 1550-1851*, a database is being created at the Royal Museums at Greenwich based on research into the scientific instrument trades in the second half of the nineteenth and the early twentieth century, up to 1914. The research so far has focused on trade directories and advertisements, with additional material from catalogues and family history and biographical sources. This material is providing a useful resource for tracing some of the links between different manufacturers, such as which firm succeeded another at a particular address, changes in partnerships and company organization, evolution of the kinds of instruments offered for sale, and who was supplying instruments made by someone else. Examples will be given of some of the links which have been traced and an attempt made to examine the light these throw on changes in the industry during the period under review.

Marcus GRANATO | Museum of Astronomy and Related Sciences, Brazil

Thesaurus of Scientific Instruments in Portuguese: the launch and next steps

The preservation of scientific heritage is a major challenge in present-day society. Dispersed through a multitude of institutions – from universities to schools and research laboratories – and unprotected by cultural heritage legislation, the preservation of scientific heritage needs to gradually change from a museum-based approach to an approach increasingly oriented towards in situ preservation, sustained by networks and partnerships at the national and international scale. This shift has several implications in training and the provision of reference materials. One of them is a thesaurus for terminology classification. The Thesaurus project was initiated in 2006 under the coordination of the Museum of Astronomy in Rio de Janeiro and the Museum of Science of the University of Lisbon. It was inspired by similar terminology control initiatives in France and Italy and it involved a network of 12 museums and collections from Brazil and Portugal: in Brazil, Pedro II Secondary School (Rio), Museum of the Polytechnic School (Rio), Museum of Science and Technique (Juiz de Fora), Museum of Pharmacy (Juiz de Fora), Museum of Science and Technology (Ouro Preto), Museum of Pharmacy (Ouro Preto); and in Portugal, Science Museum (Coimbra), Museum of Science (Porto), Museum of the Faculty of Engineering (Porto), Museum of Physics of the High Institute of Engineering (Lisbon), Museum of the High Institute of Engineering (Porto). It encompasses more than 60,000 scientific instruments from the 18th to the 20th century. The Thesaurus of Scientific Instruments in Portuguese is finished and ready to be launched online, in paper version and in DVD. In this paper we present the results and impact of the collaboration project and we evaluate and discuss how its major difficulties were overcome. We also present the next steps of its development, particularly in terms of multi-language approach, with a focus on Spanish and English, and as a tool for collection databases.

This presentation is based on work co-authored by Marta C. Lourenço.

P132. Sonic skills at work: listening as an entrance to knowledge acquisition

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Sat 27 July, 11:10–12:40 • Schuster Bragg

Symposium organiser: **Stefan KREBS** | Maastricht University, Netherlands

Symposium abstract

Historians and sociologists of science, medicine and technology have recently stressed that scientific work involves more than visual observation alone. The introduction of measurement devices that appear to require and prioritize reading and visual inspection of results has not, in fact, ruled out the deployment of scientists' other senses. On the contrary, scientific work often depends on bodily skills, one of which is listening. And yet, listening remains a less generally accepted means of knowledge production. Our session aims to understand the contested position of listening in knowledge production by studying the role and status of sonic skills; that is, of listening skills as well as other skills needed to employ the tools and instruments for listening.

The papers in this session have two common sets of questions: First, how have scientists, physicians and mechanics employed their ears, tools and instruments to make sense of the sounds they studied and depended on in their practices? What kinds of knowledge (technical or other) have been required and acquired to mobilize sonic skills in their work, and what kinds of new knowledge have been yielded? Secondly, where, when and why did, and does, listening remain contested nonetheless?

The three papers cover four different sites of knowledge production in three different historical periods. Cases range from the recording of natural phenomena by ornithologists during the interwar period, to the 'auscultation' of human bodies and car engines by physicians and car mechanics in the postwar period, 1950-1970, and closing with a more recent history of auditory displays developed for complex data sets by an interdisciplinary community of scientists. Together these case studies investigate historical changes in the skills required to listen, as well as in the epistemic status of listening. They show how sonic skills exist and are redefined alongside new technologies, and how they are intertwined with the establishment of professional and scientific identities.

Chair: **Hans-Joachim BRAUN** | Helmut Schmidt University, Hamburg, Germany

Joeri BRUYNINCKX | Maastricht University, Netherlands

Listening Acoustically: Sonic Skills, Tools and Knowledge in Ornithological Field Recording

Over the twentieth century, bird vocalizations have become a key site to study biological mechanisms of evolution, behavior and perception. For the study and collecting of these vocalizations, in the field-site as in the laboratory, biologists often relied to a large extent on their listening skills. This paper traces the changing organization and status of (mediated) listening practices as a way of gaining and producing new knowledge, as well as the recognition of listening as a marker of a specific professional expertise. Drawing on analysis of ornithological journals, archived correspondence and field notes, this presentation follows the introduction of several new technologies and instruments for the recording and analysis of acoustic phenomena in the interwar period, in both Britain and the United States. By the late nineteenth century, the

practice of aural field observation emerged largely outside academic ornithology, which was focused primarily on museum taxonomy. In an attempt to legitimize the sonic as an entrance to gain new knowledge, amateur naturalists and some professional ornithologists presented their expert hearing as informed by systematic attention and musical experience. Ornithologists fashioned themselves as 'scientist-musicians' and prided themselves on the musical ear with which they recorded and analyzed natural sounds. But with increased interest in aural observation, naturalists became critically divided over the presumed adequacy of musical knowledge. The introduction of the electrical microphone, phonograph and sound-camera in field-recording in the 1930s by institutes such as Cornell University and the British BBC, however, largely side-tracked the issue of notation. At the same time, the 'mechanical ear' changed the epistemic status and organization of listening in scientific work. Not only did it expose unmediated human listening as 'selective' and 'subjective'; the expensive and technically complex equipment also re-located listening expertise with just a small group of professional recordists and ornithologists, who learned to judge and discuss their subject now in acoustic rather than musical terms. Acquired knowledge of sound engineering in turn influenced the way the field was being experienced, as the 'unselective' mechanical ear picked up so much interference and noise that scientists had to learn and develop new techniques and instruments for selective and focused listening.

Stefan KREBS | Maastricht University, Netherlands

Melissa VAN DRIE | Labex CAP- Sorbonne Panthéon / EHESS, France

How to use a Stethoscope: Diagnostic Listening Practices of Medical Physicians and Auto-Doctors

Since the early years of the trade, car mechanics linked their craft skills to the clinical expertise of medical physicians. They claimed to use such methods as differential diagnosis or to employ their ears to listen for technical flaws: "If the physician cannot make his diagnosis by the appearance of the patient, he will take his stethoscope and listen to the patient's body. This is how you ought to proceed with your car engine as well." In this popular image "auto-doctors" shared a symbolic and practical tool with medical physicians: the stethoscope. However, this was not a one-sided comparison, as car mechanics' listening practices were equally acknowledged by physicians. In one 1960s medical handbook dedicated to the practice and technique of auscultation, a sound-comparing stethoscope, the sphygmograph, is introduced through reference to similar instruments used by car mechanics to locate missing cylinders. Mediate auscultation, or diagnosis using a stethoscope, initially marked an important shift in the construction of medical knowledge and the definition of professional expertise. However with the advent of more visual and measurable forms of diagnosis in the 1950s and 1960s, auscultation's real potential is more and more frequently put into question or neglected because it is deemed a subjective, expert, individualized practice. Roughly at the same time, similar shifts from sonic to visual means of diagnosis occurred in the car mechanics trade. The practice of diagnostic listening became contested by new instruments like the oscilloscope or the lung X-ray which were depicted as more objective and reliable than the expert ear. Our presentation will explore these connections, investigating the sonic practices of the two very different fields of medical auscultation and car mechanics. We will reveal how and when listening was considered a legitimate tool for knowledge acquisition. The focus lies in explaining the bodily technique of diagnostic listening: the mode of listening physicians and mechanics employ to detect and identify bodily pathologies and technical malfunctions. Through close readings of trade journals and medical textbooks appearing in the first postwar period (1950-1970), we will compare descriptions of the types of skills developed in these parallel forms of auscultation. Furthermore, we will reflect on the epistemic status of the knowledge which physicians and mechanics generated through these sonic practices.

Alexandra SUPPER | Maastricht University, Netherlands

Lobbying for the Ear, Listening with the Whole Body: The Contested Scientific Legitimacy of Sonification

Over the past twenty years, a scientific community has emerged which dedicates itself to the development of auditory data displays or sonifications. Much like visualisation refers to the transformation of scientific data into images, sonification translates data into sound. While sophisticated technology is not a technical precondition for sonification – a dataset can be expressed by humming or by playing a tune on the piano – sonification usually relies on the possibilities afforded by digital audio technologies; indeed, the history of the field is intimately intertwined with technological developments such as tools for sound synthesis and processing. However, the epistemic status of sonification is contested, and many scientists react with scepticism to the idea of turning their data into sound, arguing that knowledge gained through listening cannot be objective. This paper analyses the strategies used by the sonification community in its struggles for scientific legitimacy. In their quest for acceptance, the practitioners of sonification link up to older traditions of listening as an entrance to knowledge, such as the listening practices of physicians and car mechanics. At the same time, they criticise the 'visual bias' of Western science and bemoan the lack of a 'lobby for the ear'; they thus engage in an emancipatory rhetoric that promises to free the ear from its marginalised status. In doing so, they walk a tightrope between linking up to and breaking away from established scientific practice, accomplished in part through a careful navigation of the boundaries between art and science. In their ongoing struggle for scientific legitimacy, the community also cultivates a sense of *professional audition* (cf. Goodwin 1994, Porcello 2004); that is, a set of technological and perceptual skills that characterise a competent practitioner of sonification. The professional audition of sonification is a matter of listening (and indeed, of engaging in different strategies and modes of listening), but it is also a matter of tinkering with audio hardware and software and of communicating about sound – for instance, by using specialised audio vocabulary, but also by humming, singing and gesticulating. Ironically, considering that the rhetoric employed by the sonification community often talks of endorsing the ear, it is not just the ear but the whole body of the researcher which is involved in the professional audition of sonification.

Commentary: Hans-Joachim BRAUN | Helmut Schmidt University, Hamburg, Germany

P133. Knowledge for use: universities, industry and roots of the knowledge economy

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Sat 27 July, 14:10–15:40 • Schuster Bragg

Symposium organiser: Robert KARGON | Johns Hopkins University, United States

Symposium abstract

The Second Industrial Revolution of the latter nineteenth century and early twentieth centuries witnessed what has been described as the 'marriage' of science and technology. The natural sciences were enlisted in the creation of whole new industries including electric power, and light, communication, artificial dyestuffs, explosives, artificial fertilizers, pharmaceuticals, new materials, etc. These new industries demanded

scientists and engineers and consequently the emergence of a complex web of interactions among industry, universities and government.

This session proposes a comparative look at three national scientific-technical enterprises. **Jeffrey Allan Johnson** examines the origins of a knowledge-based economy in Germany by focusing on the two crucial decades 1867-1887, which saw the emergence of an academic-industrial symbiosis in organic chemistry with unique features, including favorable government policies, that made possible the emergence of a hybrid class of industrial scientists within an institutional network that could sustain both exponential growth in scientific knowledge and systematic product innovation on an unprecedented scale. By 1900 organic chemistry in Germany thus presented the classic model of an industrializing science, but as such it is perhaps somewhat misleading. Though widely envied or imitated in other contexts, it was never duplicated, and indeed by 1914 it was no longer fully applicable even in the field that created it.

Robert Kargon looks at an emerging industrial power, the United States of America. After its Civil War of 1861-1865, the US's rapid industrialization and urbanization similarly created a growth in the demand for trained experts in science and in technical fields. The late nineteenth and early twentieth centuries witnessed an unprecedented burgeoning of institutions of higher learning devoted to applied knowledge, and the creation of whole new technical professions such as chemical and electrical engineering, fire safety engineering, and industrial researchers in chemistry and physics. New patterns of cooperation were established between academe, industry and state and federal governments.

Robert Fox investigates France's response to the challenges of Germany and the USA. Abundant secondary literature expresses a long tradition of 'declinist' sentiment about late-nineteenth-century France. Blame has been directed at a supposed cultural gulf separating *savants* from *industriels* and at an indifference towards applied research that had both cause and consequences in an inadequate investment in industrial laboratories. The goal of Fox's paper is to modify and add nuance to these views. French industry, he argues, labored under local circumstances that fostered a peculiarly 'French way' on the path to modernity, one whose successes and failures should not necessarily be judged by the criteria we might apply to the industrial big guns of Germany or the USA.

Chair: Miriam LEVIN | Case Western Reserve University, United States

Jeffrey JOHNSON | Villanova University, United States

Formation of the knowledge-based economy in Germany, 1867-1914

This paper examines the origins of a knowledge-based economy in Germany by focusing on the two crucial decades 1867-1887, which saw the emergence of an academic-industrial symbiosis in organic chemistry with unique features, including favorable government policies, that made possible the emergence of a hybrid class of industrial scientists within an institutional network that could sustain both exponential growth in scientific knowledge and systematic product innovation on an unprecedented scale. By 1900 organic chemistry in Germany thus presented the classic model of an industrializing science, but as such it is perhaps somewhat misleading. Though widely envied or imitated in other contexts, it was never duplicated, and indeed by 1914 it was no longer fully applicable even in the field that created it.

Robert KARGON | Johns Hopkins University, United States

The Production of Knowledge and the Rise of the U.S. as an Economic Power: Universities, Industry and Government, 1870-1914

In the United States, the last three decades of the nineteenth century and the beginning of the twentieth constituted an explosive era of population growth, industrial expansion and technological change. It was

a critical period in the relationship between science and practice, with theoretical science (especially electromagnetism and organic chemistry) creating whole new industries yielding profits and products new manufacturing techniques, quality control and organized industrial research. This paper examines the implications of these changes for the organization of research and its relationship to the larger economy in the period 1870-1914.

Dramatic changes in daily life (lighting, refrigeration, telephone, radio, steel for rails and skyscrapers, the airplane, etc.) gave rise to a new operational definition of "progress" and raised to startling levels the prestige of science and science-based technology. The demand for human resources—trained experts—to ensure scientific-technical progress was translated into the creation of new institutions of higher learning and research. This was the era that witnessed the birth of the technological university including Case, Armour Tech, Carnegie Tech, and Caltech), many industrial and government laboratories, and private, entrepreneurial research organizations such as Battelle and the Research Corporation. Changes in science itself such as the emergence of hybrid disciplines and multidisciplinary practices forced the reorganization of the funding of scientific and technological research, and led to a reorientation of the tacit partnerships between universities, industry and government.

Robert Fox | University of Oxford, United Kingdom

Science, technology, and industry in France, 1870-1914

In the forty years or so before the first world war, observers in France routinely expressed concern about the competitiveness of the nation's industry. Many looked enviously across the Rhine to a land of large manufacturing companies with fine laboratories and a ready flow of highly trained manpower emerging from an educational system adapted to the needs of the new industrial age. As historians, we are the heirs to these perceptions, which for over a century have coloured writing about France's response to the challenges of Germany and the USA. In an abundant secondary literature that takes its lead from a long tradition of "declinist" sentiment about late-nineteenth-century France, blame has been directed at a supposed cultural gulf separating *savants* from *industriels* and at an indifference towards applied research that had both cause and consequences in an inadequate investment in industrial laboratories. The goal of my paper is a fine-tuning of this interpretation rather than its wholesale rejection. French industry, as I should argue, labored under local circumstances that fostered a peculiarly "French way" on the path to modernity, one whose successes and failures should not necessarily be judged by the criteria we might apply to the industrial big guns of Germany or the USA.

Commentary: Miriam LEVIN | Case Western Reserve University, United States

T151. Philosophical issues

Wed 24 July, 16:00–17:30 ▪ Uni Place 4.213

Chair: Chiara AMBROSIO | University College London, United Kingdom

Joseph HUTTON | University of Bristol, United Kingdom

Composite paradigms in medicine: analysing Gillies' claim of the reclassification of disease without paradigm shift in the case of *Helicobacter pylori*

Since the publication of Kuhn's *The Structure of Scientific Revolutions* in 1962, the notion of paradigms has shaped the way that philosophy views scientific discovery and how changes in what is regarded as empirical fact occur. This drew heavily on examples from the history of the natural

sciences to support Kuhn's hypothesis. However, some argue that medicine is different from the natural sciences. Gillies has proposed another theory of how paradigms apply to medicine; that of composite paradigms. In doing so, Gillies uses the example of *Helicobacter pylori* and the shift from the excess-acid theory to the current bacterial-infection theory of gastric ulcers to illustrate these fundamental differences between medicine and the natural sciences. Upon analysis of Gillies' claim, it is evident that traditional Kuhnian paradigms are also composite and that the manner in which Gillies proposes disease is classified is insufficient in describing medicine. Furthermore, new local paradigms are demonstrably introduced and the change was accompanied by many of the markers of paradigmatic change including changes in worldview, resistance, incommensurability and the introduction of new questions that could not have existed under the previous paradigm. Whilst this change may not be on the scale of the Chemical revolution, it can still be considered paradigm shift. Thagard also proposes an alternate view of discovery using the case of *H. pylori*. This has much in common with Kuhnian paradigms but Thagard's theory offers further elucidation and refinement. This allows it to better characterise all of the associated features of discovery relevant in the case of *H. pylori*, thus provides a preferable tool for examination of this important recent discovery.

Lima Filho DOMINGOS LEITE | Federal Technological University of Paraná, Brazil

Sobre a origem da ciência: um diálogo entre Lukács e Sohn-Rethel

O artigo analisa a gênese da ciência enquanto categoria derivada do trabalho. Entendemos a ciência como um tipo de conhecimento humano, cuja principal característica é ser abstrato em oposição aos demais tipos de conhecimento empírico. Empírico aqui se refere à relação direta com o trabalho produtor de valores de uso. Abstrato, significa a desconexão com a produção direta de valores de uso. O materialismo precisa responder a pergunta: como é possível o pensamento abstrato desenvolver-se desvinculado da produção da vida material? O mérito de tal pergunta é de Sohn-Rethel e sua resposta parte da teoria da abstração real. Lukács, por sua vez, aborda a relação entre conhecimento, ciência e trabalho retornando a Aristóteles e Hartmann. Aristóteles trata o trabalho humano como sendo a unidade entre o pensar (nóesis) e o produzir (poiésis). Através do primeiro é posto o fim e se buscam os meios para realizá-lo, através do segundo o fim posto é realizado. Hartmann divide o pólo pensar, em dois atos, "posição do fim" e "busca dos meios". Para Lukács, a autonomização deste ato "busca dos meios" é o que dá origem ao pensamento científico. O trabalho produtor de valores de uso, era a unidade do pensar e produzir. Essa unidade se rompe dando origem ao pensamento científico. Mas como é possível o trabalho intelectual ser conduzido separadamente do manual? Sohn-Rethel explica isso a partir do conceito de abstração real. A troca de mercadorias opera atos de abstração física e temporal que precedem e determinam a abstração do pensamento. Isto desenvolveu no ser humano a capacidade de afastar-se do empírico e de criar conceitos. Até o surgimento do dinheiro (séc. VII a.C.) o polo pensar da unidade trabalho era fundamentalmente prático, empírico. Exemplo disso são os "harpedonaptes" (arte das cordas) precursores da matemática, no Egito, onde a arte de medir se servia da corda como instrumento principal, i.e., era um conhecimento que não podia prescindir do empírico. Para Sohn-Rethel, o surgimento da troca de mercadorias intermediada pelo dinheiro deu origem a abstração do pensamento e aos primeiros rudimentos do pensamento racional manifestados na filosofia grega e na matemática. O desenvolvimento da forma da mercadoria, ao longo dos séculos, possibilitou o aprimoramento do pensamento racional e sua transformação na ciência moderna, séc. XV d.C., coincidindo, não por acaso, com o nascimento do capitalismo.

On the origin of science: a dialogue between Lukács and Sohn-Rethel

This paper analyses the genesis of science as a category derived from labor. We understand as science activity that investigates the phenomenon through conceptual abstraction resulting in theories. In this sense, science is only one kind of human knowledge, whose main characteristic is to be abstract as opposed to the kinds of empirical knowledge. Empirical refers to the direct relationship with the work that produces use values. Abstract, therefore, means the disconnection with the direct production of use values. Materialism must answer the question: how is it possible to develop abstract thinking disconnected from production of material life? Who elaborated this question was Sohn-Rethel and his answer departs from the theory of real abstraction. Lukács, however, states the relationship among knowledge, science and labor by returning to Aristotle and Hartmann. Aristotle treats human labor as the unit between "thinking" (noesis) and "producing" (poiésis). Thinking means to posit the goal and to investigate the means of its realization. Producing means to attain the realization of the goal thus posited. Hartmann divides the thinking, in two acts, "the positing of the goal" and "the investigation of the means." For Lukács, when "the investigation of the means" becomes autonomous gives rise to scientific thinking. But how intellectual labor can be conducted separately from the manual labor? Sohn-Rethel explains this from the concept of real abstraction. The commodity exchange operates acts of physical and temporal abstraction that precedes and determines the thought abstraction. This developed in human beings the ability of turning away the empirical and creating concepts. By the emergence of money (around the seventh century BC) the "thinking" was fundamentally practical and empirical. Examples are "harpedonaptes" (art of strings) that were the precursors of mathematics in Egypt, where the art of measuring used the rope of his main instrument, i.e. knowledge could not dispense the empirical acts. For Sohn-Rethel, the emergence of commodity exchange mediated by money developed in the human beings the capacity of thought abstraction rising to the first principles of rational thought expressed in Greek philosophy and mathematics. The development of the commodity form, for centuries, allowed the improvement of rational thought and its transformation in modern science, by the fifteenth century AD, coincided, not by accident, with the birth of capitalism.

This presentation is based on work co-authored by Dayani Aquino.

Commentary: Chiara AMBROSIO | University College London, United Kingdom

T152. Gender at work

Tue 23 July, 16:00–17:30 ▪ Roscoe 1.009

Chair: Vicky BLAKE | University of Leeds, United Kingdom

Éva VÁMOS | Hungarian Museum of Science, Technology and Transport, Hungary

How scientific knowledge and gender tactics learned abroad helped women scientists in the interwar period (1920-1939) in Hungary

For Hungarian women scientists research experience abroad and international examples and connections were very important and useful. The history of university women in Hungary started with a degree earned abroad by Dr. Vilma Hugonnay, a medical doctor and countess, who had

studied in Switzerland. Aristocratic, noble and middle-class women's education included learning, first of all, German, then French and even English. As women's knowledge of these languages were, in many cases, outstanding they were successful candidates for postdoctoral foreign grants of the period.

For women striving after scientific careers in the interwar-period Hungary "the example of higher developed countries" as they were called, was a natural source of scientific knowledge and gender tactics in the field. Hungarian women found it quite natural to study abroad for a shorter period. After graduation women frequently went to foreign countries as holders of state or private grants. In the Interwar Period women often obtained 3-5-months postdoctoral grants either from the so-called Collection University or the Federation of Hungarian University Women. The Collection University aimed at centralizing the scarce sources of financial support available to graduated people with scientific and cultural aspirations. Young people could apply to this agency for the support of travel grants – men and women alike. The statutes of the Collection University promised privileges in obtaining state employment after finishing the grant period. We very often find that women could not get employment after returning home.

A very good research place for women physicists was the Vienna Radium Institute. In her outstanding book on women working in this institution, Maria Rentetzi gives a detailed description of the results of the Hungarian woman researcher dr. Elisabeth Róna. The Federation of University Women helped women's postgradual studies abroad on the basis of individual applications. Such was the case of botanist Erzsébet Kohl. A Smithsonian grant allowed her to collect snow algae in Alaska. Her collection still exists in Budapest.

Examples of the pertinent activities of both organisations will be given in the paper, and it will prove that these grants were not sufficient to start scientific careers in Hungary.

Isabelle LÉMONON WAXIN | Centre Alexandre Koyré - EHESS, France

The invisibility of French women's contributions to science in the eighteenth century: a gendered question?

It is well-known that the 18th century in France saw the multiplication of "salons" which were led by women and where mathematics or science could be discussed as well as literature. These well-known women usually brought together the brightest male minds of the time and were not really involved in the process of building or using mathematics and science.

Yet, some barely known women really took part in the process of developing science. Their records are very faint, and they cannot be easily traced : one has to investigate a broad field of sources to have access to their work. This invisibility, as has often been argued, is partly due to their exclusion of institutional positions and their confinement to the domestic sphere. This paper will present some of these "homemade" contributions to science and try to analyze them in terms of calculations, modeling or teaching and communicating. It will also underline the influence of domestic economy on the knowledge produced, as well as the importance of varied sources to understand their "choice" for homemade science.

This paper will especially study the very broad, in terms of geography and disciplines, networks these women created through homemade science. The analysis of these networks aims at questioning the invisibility of these women, who were in fact well-known to the "savants" of the Enlightenment, but were completely forgotten by historiography.

Nahomi GALINDO MALAVÉ | Universitat Autònoma de Barcelona, Spain

'First for the family, ... and second, for society': health, penitentiary, gender and empire in the

birth of the Escuela Industrial de Vega Alta, Puerto Rico, 1940-1955

This article explores how cultural intersections between modern crime, law, and health operate differently, for gender-related reasons, in prison spaces for women. It seeks to contribute to the existing historiographical studies of health, gender and penitentiaries by focusing on the first penitentiary built exclusively for women in Puerto Rico, the Escuela Industrial de Mujeres Vega Alta (EIVA). This prison opened its doors in 1954 – two years after the Commonwealth Constitution entered into effect – when it began to operate as an institution of social control. The opening of the EIVA was a product of the convergence of five main factors. First, the limitations of the penal infrastructure at the time resulted in dire overcrowding, and therefore hygiene and health problems that required urgent attention. Second, the interest of women's group, like the Spiritist Ladies' Club and the Association of Social Workers, in the problem of overcrowding in mixed penitentiaries. Third, a process of resignification of criminality – and specifically women's criminality – as a social problem, that was as much cause as it was effect of the disarray generated by capitalist modernization. Both the "crisis" of overcrowding and the "problem" of growing criminality, including female criminality, confronted the young State, through the lens of its emerging discourses and practices of social control: in this context, penal reform and "rehabilitation". Fourth, the political tensions surrounding the creation of the Commonwealth, which came to fruition in the Nationalist Revolt of 1950, in which several prominent women leaders participated (and were jailed as a result). And Fifth, EIVA attempted to fulfill the objectives of laws through which it was created: to rehabilitate female inmates, first, for family life, and second, for society. Within EIVA, as part of the "rehabilitation" process, gender roles considered appropriate for the female inmates were reinforced. However, female inmates' bodies were not domesticated in a homogenous way. On the contrary, this process was very complex. Although there are examples of "successful" domestication, there are also examples of resistance and negotiation.

T153. New themes and approaches in science studies

Thu 25 July, 09:00–12:30 • Uni Place 4.213

T153-A. Interdisciplinarity

Thu 25 July, 09:00–10:30 • Uni Place 4.213

Chair: Fern ELSDON-BAKER | Coventry University, United Kingdom

Leyla Mariane JOAQUIM | Federal University of Bahia, Brazil

On the relation between physicists and biology: some contemporary perspectives

Physicists have often in history turned their attention to the phenomena of life. They've been attracted to biology for several reasons such as the use of technologies of physics to study biology, the expectation that living matter could be reduced to physical principles or the appeal of a science of life after the military use of atomic energy. My project investigates the circumstances under which physicists approach biological problems both from historical and contemporary perspectives. The present paper comprises my project's contemporary part, which investigates the current influx of physicists into the field of biology and I use oral history as one of the methodological tools. I interviewed physicists who work on biological problems in those areas concerned with systems, dynamics and the organization of the cell, particularly systems biology. In the context of the post-genomic era, the scientific

challenge of converting data into knowledge is dependent on high-throughput technologies and computational modelling, which increase the need for interdisciplinary collaboration (cf. Keller 2002). Because of its interdisciplinarity, the field of systems biology has been subject of sociological investigation (e.g. Calvert & Fujimura 2012) and our analysis focuses on the physicists that are, one more time in history, playing a central role in biological research. Up to now, I interviewed and recorded research group leaders and postdoctoral researchers from Germany, Israel and Brazil. The results are also based on visits to laboratories, observations of interdisciplinary interactions, meetings, informal conversation and e-mail exchanges, as well as the scientific, historical and theoretical literature. In the discussion, I focus on epistemological issues derived from the interdisciplinary environment, such as cultural gaps between the disciplines and the modelling strategies.

Dmitriy MYELNIKOV | University of Cambridge, United Kingdom

Putting genes into mice: disciplinary transits, recombinant networks and the making of transgenic technology

Genetically modified mice were first reported in 1980–81 by five different labs working independently in the USA and Europe, in diverse disciplinary contexts. What these groups had in common was a combination of expertise and practical experience in molecular biology, especially the new methods of detecting recombinant DNA, and the developmental biology of the mouse. All of them also had access to the growing network of academic centres where new genes were being isolated, purified and introduced into different cells. These ‘transgenic’ mice were thus made possible by networks of academic researchers sharing materials, results and techniques. The moral economies of sharing biological materials and exchanging techniques have been explored as a key aspect in the history model organism communities, especially at the time of their making. In the 1970s, the changes in the politics of science had a significant impact on the experimental and communicative practices of biological research. The debates and regulation surrounding recombinant DNA affected experimental programmes and limited the sites where they could be pursued. Heightened media attention to molecular biology made the day-to-day practices of the laboratory visible, and encouraged more scientists to engage with broader audiences. The increasingly important role of commercial interests and research sites affected the politics of sharing resources and information, but also expanded the permissible arenas for announcing discoveries. The expansion of molecular biology to higher organisms and the concurrent molecularisation of developmental biology have been considered by some scholars, but much remains to be understood. This paper places developmental biologists, geneticists and molecular biologists who tried to introduce foreign genes into whole mice in the context of biomedical research of the late 1970s. It explores how different scientists, most of them in well-funded and established groups, engaged with the expanding field of recombinant DNA research and adapted its practices and agendas to their work, before the cutting-edge tools it required were widely disseminated or standardised.

Cheryl LANCASTER | University of Durham, United Kingdom

How teratomas became embryonic stem cells: an example of interdisciplinary knowledge production

This paper will discuss the importance of interdisciplinary research in the development of teratoma research to embryonic stem cell research. This has encompassed the fields of cancer biology, pathology, cell biology & embryology. Teratomas – tumours of the testes or ovaries – can develop several tissue types in various stages of differentiation, including hair, teeth & muscle, for example. These tumours were therefore identified as potentially useful in studying early development & differentiation (given the ethical & technical difficulties in examining development in the actual foetus).

In the 1950s, Leroy Stevens working at Jackson Laboratories identified an inbred strain of mice particularly prone to developing testicular teratomas, & developed this strain to study these tumours. Several researchers identified the potential of using teratomas to study development, which was made possible when Barry Pierce (a recent graduate of medicine & specialist in pathology) developed a cell biology technique to produce ‘embryoid bodies’ from teratoma cells. This enabled tumour cells from Stevens’ original strain to be transferred to laboratories around the world.

Utilising these more accessible tumours, understanding of teratomas developed. Pierce & Frank Dixon used cell biology & histological methods to demonstrate that teratomas had a stem cell population. This was confirmed a few years later by Martin Evans & Gail Martin, who isolated these stem cells & cultured cell lines – cells which became known as embryonic carcinoma cells (ECCs), allowing pluripotency to be studied in the laboratory. At this point normal pluripotent embryonic cells had not been isolated & cultured successfully, & were therefore unavailable for research.

Isolated ECCs were then used to create chimaeric mice, a technique developed in the 1960s & 1970s. This not only demonstrated that teratoma cells were capable of contributing to normal development, but the techniques developed also allowed eventual creation of mouse models of disease – an essential tool utilised in current research. Methods learned from this research were then used by both Martin & Evans to individually isolate pluripotent embryonic cells in 1981. Martin used her skills in cell biology to produce her cell line, whereas Evans worked alongside Mathew Kaufman to manipulate early embryos. This demonstrates how the increasing availability of techniques (& disciplines) in biological sciences allowed stem cell biology to progress.

T153-B. Current problems and approaches

Thu 25 July, 11:00–12:30 • Uni Place 4.213

Chair: Iwan Rhys MORUS | Aberystwyth University, United Kingdom

Ang Li | INSTITUTE FOR THE HISTORY OF NATURAL SCIENCES, CAS, China

Who shall finance the public biological databases? A case study of BIND

Biology has increasingly turned into a data-rich science. Since the first biological sequence database was created in 1960’s, the need for storing and communicating large datasets has grown tremendously. To cope with these needs, a lot of databases had been created. Most of them vanished in a few years; some of them got strong financial support from governments and became dominant in biological research, while others might be commercialized and be used in special fields.

BIND (the Biomolecular Interaction Network Database) was a web-based system, archives biomolecular interaction, complex and pathway information. It was developed by a team led by C.W. Hogue from University of Toronto, published by 2001, and was connected with Genbank. From 2003, the new government of Canada became less interested in supporting public databases like BIND, ergo left it with a series of financial problems. Prof. Hogue managed to run it until 2005 by seeking collaborations with the government of Singapore and made the database well known in the field. After 2005, the Singapore government also gave up on supporting BIND led the database suspended updating. The Fates of similar databases need further observation. But it was widely understood to manage a massive database like BIND requires strong finance support and high level human resources. This paper reviewed the development of BIND and discussed how the intellectual property, the national policies and international collaborations affected its funding resources. It raises questions rather than answers, and hopefully

might draw more public attention on the funding issue of biological databases.

Vanessa HEGGIE | University of Birmingham, United Kingdom

Macro-bioprospecting: global histories of science through Pemmican and Vibrams™

This paper examines the adoption, reconstruction and distribution of two quotidian objects – a footwear and a kind of food – both of which were, at least nominally, based on the technologies of indigenous populations, but refigured into tools of imperialism, military technologies, and consumer goods. By broadening our attention from the pharmaceutical, botanical and genetic aspects of bioprospecting we open up a range of human technologies and cultural adaptations to closer scrutiny; these two case studies demonstrate how doing so provides new insights into crucial topics in the history of science and technology, particularly the co-construction and communication of knowledge, and the relationship between national and supra-national knowledge communities.

Specifically, pemmican is used to demonstrate the feasibility of global histories of science, while the science behind the various Vibram-style training shoes is shown to have a difficult, and largely unstudied history based in racial and evolutionary science; both are unavoidably products of a colonial past

Noemi TOUSIGNANT | University of Cambridge, United Kingdom

Interrupted progressions: history, toxins and postcolonial time in Senegalese toxicology

This paper posits the postcolonial history of Senegalese toxicology as an ongoing effort to sustain the temporalities of advancing careers, collective development, technical innovation, cumulative knowledge and public protection. In the face of ending transnational collaborations, waning means, equipment breakdown or new patterns of intoxication, Senegalese toxicologists struggle to remember, recount and reactivate the lost rhythms and futures of their scientific activity. In this paper, I consider various implications of writing intense preoccupations with the promises and fragility of continuous, progressive time into the history of science. First, I suggest that the orientation and fragmentation of time opens new possibilities for the analysis of science as politics in its engagements with the political economy of toxic hazards in Senegal. Secondly, I discuss the different ways in which progression and its interruptions qualify this history as postcolonial. Finally, I explore how scientists' historical accounts and temporal desires might relate to Michel Serres' reflections on non-linear models of the time of the history of sciences.

T154. Sources and biography

Sat 27 July, 14:10–17:40 • Uni Place 1.219

T154-A

Sat 27 July, 14:10–15:40 • Uni Place 1.219

Chair: David DUNÉR | Lund University, Sweden

Christiane Liliane NIVET | Université Paris7 Denis Diderot, France

Was Gregor Mendel subjected to feudal servitude before becoming a monk in 1843?

Our knowledge of the young Mendel's life prior to his admission to the monastery of Saint Thomas in Brno (Moravia) comes essentially from the curriculum vitae he submitted in 1850. His first biographer Hugo Iltis used this document as a sort of autobiography, although the document

contained various voluntary omissions and inaccuracies. We have sought the reasons for these and in so doing have discovered why Mendel's entry into religion had become ineluctable

Christine AICARDI | UCL, United Kingdom

Francis Crick: broker of multidisciplinary networks of trust

In Francis Crick's notes for a Memorial Lecture entitled 'My Life in Science' that he gave towards the end of his life, one finds at the very end: "Finish: Two General Remarks: (1) Importance of close collaboration [...], (2) How to bridge fields, e.g. protein chemistry and genetics, now: neuroscience and consciousness." From molecular biologist / geneticist James Watson in the 1950s to neuroscientist Christof Koch in Crick's last two decades, the importance of close collaborations to Crick's scientific career is well-known although unequally documented by historians. That Crick would consider the skill to bridge disciplines on a par with close collaborations as the most salient aspects of his life in science is more intriguing; unsurprisingly so, since the historiography on Crick has largely concentrated on his flamboyant individuality, his Cambridge years and his research contribution to molecular biology and genetics, while it has left underexplored his involvement with the Salk Institute for Biological Studies and neuroscience.

The present paper aims at understanding why, looking back on his career, Crick would so value the skill of bridging disciplines: what recognisable professional achievements, beside the usual yardstick of scientific production, could it have led to? To answer the question, the paper focuses on Crick's 'wider circle' rather than his close collaborations, and tracks continuities between his practices at the MRC Laboratory of Molecular Biology (Great Britain) and at the Salk Institute (California); while methodologically, it borrows both from historical studies of scientific communities and sociology of social networks, in particular recent scholarship on networks of trust. As a result, the paper shows how throughout his career, Crick actively contributed to build multidisciplinary research networks that fitted with his distinctive worldview, and how in the process, he helped shape, and establish strong transnational connections between, the two research institutions that he inhabited in the course of his career. The paper fits into a wider research project embracing Abir-Am's emphasis on "intermediary units of socio-historical analysis [...]" such as research schools, circles, clubs, and other informal gatherings [...] for comprehending the history of many transdisciplinary fields in twentieth-century science", prominently molecular life sciences (Abir-Am, 1991, "Noblesse Oblige: Lives of Molecular Biologists", *Isis*, 82: 342-343).

Henrik Kragh SØRENSEN | University of Aarhus, Denmark

When mathematics teachers fight: Hansteen's and Holmboe's biographical constructions of Abel's legacy

The present paper is a contribution to a "meta-biography" of the Norwegian mathematician Niels Henrik Abel (1802–1829). Abel was born in 1802, when Norway formed part of a union with Denmark, and he was educated at the still very young University in Christiania (now Oslo) during a time when Norway entered into a union with Sweden after a brief spell of independence. He became internationally renowned through his mathematical research that was published mainly in Berlin, and he died before the Norwegian state (or any other state, for that matter) could provide him with a permanent income. Thus, the mathematician Abel lived a life fully worthy of a romantic, neglected and defiant hero or martyr. Yet, whereas all of these points were material to Abel, they became symbolical to the next generations of Norwegian mathematicians, who could use Abel's legacy – both the real intellectual one and the more metaphorical self-promoting one – for positioning themselves in on-going debates.

This meta-biographical approach sheds new light on the debates about mathematics in Norway during this period and should thus be read

mainly as an analysis of the professionalization and internationalization of that discipline in this particular peripheral setting. The present case focuses on the very first biographical accounts of Abel written by his teachers and friends. Not only were these people who had known Abel personally during his very short life, but they also knew how to construct and use Abel's legacy for the time after his death. Thus, when the popular biographies written by Abel's teachers – B. M. Holmboe (1795–1850) and Christopher Hansteen (1784–1873) – are analysed, these provide insights into the professional discussions concerning the roles of mathematics in Norway in the mid-nineteenth century. As teachers of mathematics, Holmboe's and Hansteen's controversy also included the proper means and ways of teaching mathematics.

Nicholas DUVALL | Independent scholar, United Kingdom

Mostly memoir: autobiography in twentieth-century forensic medicine

Autobiography has been a hitherto underexploited resource for the history of science, technology and medicine, despite its importance as a means for the dissemination of knowledge to lay audiences. While precautions regarding authorial licence must be observed, autobiographies can provide the historian with a valuable insight into the public face of a scientific or medical field and its practitioners. This paper examines the memoirs of two leading figures in one of the early- to mid-twentieth century's most visible disciplines, forensic medicine. The authors, Sydney Smith and John Glaister Jr., professors of medical jurisprudence at Edinburgh and Glasgow universities respectively, published their memoirs, 'Mostly murder' and 'Final diagnosis', in 1959 and 1964 after retirement. At the same time, they also contributed to newspaper serializations of the highlights of their careers, which had begun in the second decade of the twentieth century. In these works, they reflected on past cases, including dramatic courtroom clashes, as well as considering their discipline's future. The paper will show that these books and articles presented an idealized picture of their authors, who were portrayed as fiercely impartial and sometimes iconoclastic defenders of justice. Similarly, their scientific techniques appeared to constitute an often inexorable force against the criminal. This was particularly apt at a time of uncertainty for the future in Britain of forensic medicine, which had been left out of the National Health Service. Glaister, in particular, used his book as a manifesto for his discipline's place at the centre of the criminal justice system. The paper also considers the nature of authorship. Both Smith and Glaister's books were ghost-written. This raises questions about the extent to which practitioners had control over their public images. In particular, the correspondence of the two men shows their concern over their portrayal in the press.

T154-B

Sat 27 July, 16:10–17:40 ▪ Uni Place 1.219

Chair: **Christine AICARDI** | UCL, United Kingdom

David DUNÉR | Lund University, Sweden

Emanuel Swedenborg's natural philosophy and the metaphors of the mind

What is matter? One of the major themes in Emanuel Swedenborg's thinking is the relation between the material and the immaterial, body and soul. During all his life, as a scientist and a visionary, Swedenborg (1688–1772) pondered on these questions. How can we get knowledge about the invisible? The world beyond the scope of our senses? The issue here is to explain the cognitive foundation of his matter theory expressed in his early scientific works, written before he became a visionary and mystic. Namely, I do not want to know just what he thought, but also how. In focus is the relation between environment and cognition that gives rise to theories of nature: how we think about that we can not see; how we understand the invisible through the visible. From the known we understand the unknown. In my book *The Natural*

Philosophy of Emanuel Swedenborg: A Study in the Conceptual Metaphors of the Mechanistic World-View (Dordrecht: Springer Verlag, 2013) I put forward a cognitive-historical approach to history of science in order to explain concept formation in science. In this paper I explain, firstly, Swedenborg's mechanistic worldview and metaphorical way of thinking up to the year 1734, and secondly, put forward new perspective of the mechanistic philosophy of the 17th and 18th century, i.e. the cognitive metaphors of the mind and its role in the formation of scientific theories. This approach can also cast new light on Swedenborg's later spiritual philosophy and doctrine of correspondences.

István JANKOVICS | Gothard Astrophysical Observatory of Eötvös University, Hungary

Ildikó VINCZE | Gothard Astrophysical Observatory of Eötvös University, Hungary

A scientific friendship between Eugene von Gothard (1857-1909) and Maximilian Wolf (1863-1932), based on the their letters

From the 58 original letters from Herény (Hungary) and the copies of 12 replies written in the "Kopierbuch", Heidelberg by Max Wolf, we can follow the cooperative activity of two European specialists in the development of observation technology in the new science, astrophysics.

Based on the century-old documents we can retrace the development of the relationship between Gothard and his younger colleague working in the creative atmosphere at the University of Heidelberg, which was only a scientific connection at the beginning, but later it grew to be a friendship. Contemporary documents from the end of the 19th century have preserved the everyday questions of the two experimenting scientists as they were working to reveal the secrets of the Universe with the help of photography and spectroscopy.

Astronomical instruments are made custom-built for thought-out and clearly determined research goals after determining necessary precision. The most intricate details of such a process are revealed when reading the letters of Eugene von Gothard and Maximilian Wolf. We can follow the details of how the transit instrument of Heidelberg was born in 25 letters, on 78 pages. In Eugene von Gothard and Max Wolf's discussion, apart from working out modern technical solutions necessary for the scientific task, accurate determination of time and localization, there are also a lot of references to the contemporary industrial background, which was indispensable for constructing the perfect instrument.

Kostyantyn VASYLYEV | Odessa National Medicine University, Ukraine

Николай Васильевич Склифасовас

Доктор Н.В. Склифасовский один из первых в Российской Империи стал проводить успешные овариотомии. Гимназию он окончил в Одессе в 1854 г. В 1854-1859 гг. он получал высшее медицинское образование в Московском университете. В 1859-1870 гг. он работает в Городской больнице Одессы. Первая успешная овариотомия была произведена Склифасовским в Одессе в 1864 г. С 1869 г. Склифасовский профессор в Киевском университете, с 1870 г. – в Медико-хирургической академии в Петербурге, с 1880 г. – в Московском университете, а в 1893-1900 гг. – директор Клинического института для усовершенствования врачей Великой княгини Елены Павловны в Петербурге. Проф. Склифасовский один из лидеров в хирургии и оперативной гинекологии в Российской Империи последней трети 19 в. Тем больший интерес представляет изучение его научных связей с зарубежными учеными, в том числе с британскими. В 1868 г. доктор Склифасовский специально едет в Соединенное королевство: в Эдинбург к проф. Simpson – наиболее выдающемуся шотландскому акушер-гинекологу, и в Лондоне в Samaritan Free Hospital for Women к доктору Wells, который к тому времени был и was surgeon to Queen Victoria's household. Доктор Wells один из основоположников оперативной гинекологии. К концу

1860-х годов он произвел самое большое число овариотомий в мире - более 200. Он автор книги «Diseases of the ovaries—their diagnosis and treatment» (L., 1865). Посещение наиболее выдающихся британских акушер-гинекологов и личное знакомство с их оперативной техникой доктором Склифасовским способствовало распространению британского опыта в производстве этой важной операции, возможности которой так недавно еще оспаривались лучшими авторитетами в хирургии, в Российской империи. Уже в первых своих научных публикациях после возвращения на родину Склифасовский ссылается на британских ученых-медиков (журнал «Медицинский вестник», 1868, № 9-11). Таким образом, в сообщении прослеживается, как знания путешествовали между западом и востоком и значение этого процесса для развития медицинской науки в 19 веке.

Nikolai Sklifosovsky (1836-1904) and the British obstetrician-gynecologists Sir James Young Simpson, 1st Baronet (1811-1870) and Sir Thomas Spencer Wells, 1st Baronet (1818-1897)

Dr. N.V. Sklifosovsky, one of the first in the Russian Empire, began to carry out successful ovariectomy. He graduated from high school in Odessa in 1854. In 1854-1859 he received a medical degree at Moscow University. In 1859-1870 he works in the City hospital of Odessa. The first successful ovariectomy was performed by Sklifosovsky in Odessa in 1864. Since 1869 Sklifosovsky worked as a professor at Kiev University and since 1870 in the Medical-Surgical Academy in St. Petersburg, since 1880 at Moscow University, and in 1893-1900 he was a Director of the Clinical Institute for Advanced physicians of Grand Duchess Elena Pavlovna in St. Petersburg. Professor Sklifosovsky was one of the leaders in surgery and operative gynecology in the Russian Empire, the last third of the 19th century. The study of his scientific contacts with foreign scientists, including the British ones reveals greater interest. In 1868 Dr. Sklifosovsky purposely travels to the United Kingdom, i.e. Edinburgh, to the professor Simpson, the most distinguished Scottish obstetrician-gynecologist, as well as to London in Samaritan Free Hospital for Women to Dr. Wells, who at that time was the surgeon of the Queen Victoria's household. Dr. Wells was one of the founders of operative gynecology. By the end of the 1860s he carried out the largest number of ovariectomy in the world, i.e. more than 200. He was the author of the book «Diseases of the ovaries-their diagnosis and treatment» (L., 1865). Visiting the most outstanding British obstetrician-gynecologists and personal acquaintance with their operative technique by Dr. Sklifosovsky promoted spread of the British experience in carrying out this important operation, the possibility that only recently has challenged the best authorities in the surgery in the Russian Empire. Already in his first scientific publications since his return Sklifosovsky referred to the British medical scientists (the journal "Meditsinsky Vestnik", 1868, No 9-11). Thus the report traces as the knowledge is travelling between the West and East as well as its implications for the development of medical science in the 19th century.

Andreas VOURTIS | National and Kapodistrian University of Athens, Greece

Eleni BAKOU | National Hellenic Research Foundation, Greece

Athanasia THLIVEROU | University of Athens, Greece

Spreading the knowledge: Penicillin's 'apostle' Sir Alexander Fleming

Even though penicillin production was a complex collective work, Sir Alexander Fleming, the discoverer of the substance, was credited the most for this miracle antibiotic. He became the most recognized figure worldwide in relation to the penicillin success, and he was named a 'benefactor of the mankind'. Penicillin mass production and application during and after the WWII gained enormous public attention through the Media, and Fleming was invited to give lectures and collect awards from all over the globe. We put forward a new look on this hype of the time, through the previously unpublished material of Fleming's archive that is located in Athens, Greece. This archive was preserved by Amalia Fleming, the second wife of Alexander Fleming, who after his death in 1955, returned to Greece from England and took with her most of Fleming's notebooks, photographs from the trips and the ceremonies, awards and gifts, newspaper's clips concerning Fleming and penicillin, and a bulk of letters addressed to him. This archive is now being registered and organized, and this is the first attempt to communicate this historical treasure. We examine how Fleming's travels and publicity diffused knowledge on the penicillin miracle and raised the expectations on medical progress. Even though Fleming was very cautious on the use of penicillin as a panacea, the media and people's hopes eventually overwhelmed the public imagination on the abilities of penicillin. We see how the expert tried to control these reactions through numerous letters, interviews and responds to requests. We also look at how the 'accidental' nature of Fleming's discovery played its role in the construction of Fleming's legend. Our approach is putting forward questions of media coverage of science and technology, the construction of scientific facts, the image making of the scientist, but also we examine the hidden debates inside scientific community, concerning the credit of scientific discoveries. Penicillin's success kicked off the antibiotic saga of 20th century, putting medicine in a new era. Public knowledge about this new drug was therefore a key instrument on the later promotion and development of other medical breakthroughs.

T155. Early-modern mathematics

Tue 23 July, 14:00–17:30 • Uni Place 4.213

T155-A. Working cultures of early modern-European maths

Tue 23 July, 14:00–15:30 • Uni Place 4.213

Chair: J. V. FIELD | Birkbeck, University of London, United Kingdom

Gerhard WIESENFELDT | University of Melbourne, Australia

Dutch practical mathematics and the city university

When classes in practical, "Dutch" mathematics were introduced at Leiden university in 1600, the new teaching program formed a break with established traditions at early modern universities. Not only was Dutch as official language of instruction violating the long-held patterns, the intended audience of craftsmen aspiring to become surveyors and engineers did not correspond at all with the social patterns within the academic world. Historians of science as well as historians of universities have consequently treated the teaching of Dutch mathematics, which subsequently was also adopted by the four other universities in the Northern Netherlands, as an exception, if not an aberration. According to this narrative, the teaching program had only come into existence through the influence of Simon Stevin as political advisor to the Dutch Stadholder, it remained outside the university proper and – while relevant to the development of mathematical sciences – did not change the fabric of early modern academia.

In this presentation I will argue that at least for the case of Leiden, Dutch mathematics needs to be interpreted differently. Within the first quarter of the 17th century it became more and more integrated into the university structure, and played a vital role in relating the new university to the city surrounding it. Untypically for the early modern era, the foundation of Leiden University had happened within a sizeable city. Nourished by a strong influx of migrants from the Southern Netherlands and the German lands, the city quickly grew to the second largest one in the Dutch Republic and the dynamics of city politics were an important factor in the early development of the university. By relating their sciences to the city industry as well as to the humanist ideals of the university founders, mathematicians managed to acquire a significant status within the university. The institutional arrangements that were a consequence of this development had a formative role for 17th century Dutch natural philosophy.

Caitlin DOHERTY | University of Cambridge, United Kingdom

Cultural applications of Euclidian geometry in late sixteenth-century England.

The first English translation of Euclid's *Elements of Geometry*, by Henry Billingsley in 1570, is notable for the preface given to it by the mathematician, astronomer and alchemist John Dee. Though the implications for mathematical knowledge of Dee and Billingsley's work is well documented, less attention has been given to the social, economic and cultural assumptions demonstrated in this text. This paper aims to illuminate the imperial concerns evident in Dee's preface - which maintains a focus on the need for a common knowledge of abstract geometry in order to support the practical work of establishing and expanding British commercial interests, particularly those related to the quantifying of the world (through maps and globes) that Dee glosses as geometry's true purpose - whilst also suggesting the influence of the preface on contemporary developments in quantitative, diagrammatic English verse and perspectival painting techniques (Desargues' subsequent break with Euclid over the theory of parallel lines being the case to be examined here). The poetry manual of George Puttenham (*Arte of English Poesie*, 1588) will be discussed as an example of this dissemination of Euclidian knowledge, with particular reference to its inclusion of geometrical diagrams as models for socially conditioned forms of poetic composition. The contemporaneous development of the 'Mercator projection' technique of map-making will also be examined as part of this paper's central thesis that the translation of Euclid into a common language was a way of establishing the importance of mathematical knowledge as a system to guarantee both economic and cultural dominance within the context of competitive Renaissance European imperialisms.

Zaqueu Vieira OLIVEIRA | Universidade Estadual Paulista "Júlio de Mesquita Filho", Brazil

The division of mathematics in the work *Mathesis polemica* of Adriaan van Roomen

Adriaan van Roomen was born in Louvain in 1561, died in Mainz in 1615, worked as a teacher of mathematics and medicine at the University of Louvain and a professor of medicine at the University of Wurceburgo. Furthermore, wrote works in many areas of science, but his chief merit is in mathematics, in which we can illustrate your calculation for the number π to 16 decimal places and their studies about the *mathesis universalis*.

In the *Mathesis Polemica's liber primus* published in 1602, the author devotes a chapter to each of the disciplines which he considers part of the mathematical disciplines of his time. He initially classified the mathematics into main and mechanical. The main are divided into pure and mixed. The pure are subdivided into the universal which includes *logistica* and *prima mathesis* or *mathesis universalis*, and special, including arithmetic and geometry. Already mixed mathematics are subdivided according to their object of study: some address objects incorruptible, i.e. the heavenly bodies, and are included here

cosmography, uranography, geography, astronomy and chronology; other disciplines studies objects corruptible as geodesy, optics, *euthymetria* (which literally means the measure of straight lines) and music. The mathematical mechanics are divided into those which aim is the use, what is *sphaeropoieia* (the art of making beads), or action, which included *manganaria* (which refers to the art of craftsmen, but it seems that van Roomen refers to mechanaria), *mechano poetica*, *organo poetica* (the art of making organs) and *automato poetica* (the art of making machines).

According to van Roomen, not all mathematical disciplines are also needed, "the mixed are required maximally and immediately" and, on the other hand, "the pure are only required because of the mixed". Van Roomen also states that there are quasi mathematics, i.e., those disciplines which have some resemblance to mathematics, as the perspective and the arts of war.

The classification of mathematical approached by van Roomen is important to understand the status and the hierarchy between these disciplines during that period of history, and realize its importance in relation to other scientific fields such as philosophy.

T155-B. Non-western mathematics in translation and appropriation

Tue 23 July, 16:00–17:30 • Uni Place 4.213

Chair: June BARROW-GREEN | Open University, United Kingdom

Vanishri BHAT | IIT Bombay, India

Unfolding the unfounded confusion

Now it is fairly well known that Mādhava (c. 1340 CE) of *Saṅgamagrāma* arrived at the infinite series for $\pi/4$, sine and cosine functions—in a way that is profoundly different from the way it was invented in Europe much later—and couched them in the form of beautiful Sanskrit verses. What is not so well known among the historians is the intellectual atmosphere that was prevalent in Europe around 1820s when Charles Whish, a civil servant of the East India Company, discovered these series in Kerala and tried to communicate it to his counterparts as inventions of the 'Natives'. It is quite interesting to note the exchanges that took place among the three, George Hyne, John Warren and Charles Whish regarding the invention of the series by Hindu mathematicians.

From the account of some of those exchanges noted down by John Warren in his *Kālsārīkalita*, one could easily imagine the disquietude that would have been experienced by Whish at the instance of his senior officials recommending him to inquire on the discovery of the series by the 'Natives', and thereby create a certain confusion, where there was none. The kind of discomfort is quite evident from the fact that it took almost a decade for him to get his findings published in the year 1834, though Whish - based on his own studies and close interactions with the native pundits in the Malabar region - had clearly convinced himself that the series had been invented by the natives as early as mid 1820s.

Yet another confusion that had been hovering around for quite some time - even as late as 1970s - was regarding whether the text *Tantrasaṅgraha* itself includes the famous verses on the various infinite series for $\pi/4$ as also the series for sine and cosine functions. Much of this confusion had its origin from the historic paper of Whish itself, wherein he had ascribed the verses outlining these series to *Tantrasaṅgraha* of Nilakanṭha. A careful study of Whish manuscript (currently with the Royal Asiatic Society, London) of the Malayalam commentary *Kriyākālāpa* on *Tantrasaṅgraha* clearly establishes that these verses are all citations made in the commentary by Śaṅkara Vāriyar and are not part of *Tantrasaṅgraha*, a point which has been earlier emphasized by the renowned scholar K. V. Sarma based on his careful study of several manuscripts of the text.

During our presentation we plan to trace the origin of confusion related to both the issues mentioned above, and also narrate how they got themselves evaporated in due course.

Jyun-Wei HUANG | National Taiwan Normal University,
Department of Mathematics, Taiwan

和算中的圓理表及其應用

摘要

黃俊瑋

和田寧 (Wata Yasushi, 1787~1840)

是和算末期最重要的數學家，他創造許多圓理表，解決許多圓理難題，然而，其著作因1836年的一場火災而亡佚。其弟子小出兼政 (Koide Kanemasa 1797~1865)

整理過去和田寧所授書籍，於1842年寫成《圓理算經》一書。本書的第三部份羅列許多表，這些表不僅是解決數學問題的工作，同時也包含了許多數學性質與公式。在沒有微積分方法的情況下，小出利用這些表解決各類複雜幾何圖形求積與求弧長，以及它們的交周與交積等問題。

傳統開方術可處理 $a=a_1x+a_2x^2+a_3x^3+\dots+anx^n$ 之一元高次方程式開方求數值解的問題，而小出兼政則進一步發現如何求「 $a=a_1x+a_2x^2+a_3x^3+\dots+anx^n+\dots$ 」此方程式的根，他並將這類式子稱為「開方漢式」。他在《圓理算經》中造出三種「開方漢式出商表」，利用這些表可將開方式 $a=a_1x+a_2x^2+a_3x^3+\dots+anx^n+\dots$ 之中的 x 表示成 a 的冪級數展開式，並藉以求得此方程式的一個近似數值解。小出更進一步利用此開方表，處理圓理相關問題。

已知弦長與直徑求弧長之「弧背術」是傳統和算家們所感興趣的問題，而《圓理算經》不止用表求將弧背與弧積表示成直徑與弦長的冪級數展開式，並反過來

利用「開方漢式出商表」，在已知直徑與弧長的條件下，求得弦長之冪級數展開式。本研究主要透過文本分析，考察並探討其如何用「表」以求弧背公式，以及如何利用將弦表成弧長與直徑之冪級數展開式，並從和算發展的脈絡中，適當地還原小出造表之過程。

Yenri tables and related applications in Wasan

Wata Yasushi 和田寧 (1787~1840) is the most important mathematician in the early period of the 19th century in Japan. He developed many *yenri* tables (圓理表 (Tables of circle principles)) and solved many difficult problems of geometry in *wasan*. Because of a fire disaster in 1836, his work does not survive to this day. Koide Kanemasa 小出兼政 (1797~1865), one of Wata's disciples, sought to collect the mathematical knowledge from his teacher, and wrote the *Yenri sankyo* 圓理算經 (The mathematical classic of circle principles) in 1842. The third part of the treatise lists many numerical tables which not only are intellectual tools for solving problems but also manifest significant mathematical properties and formulas. Without knowledge of calculus, Koide used these tables to deal with the problem of finding the formulas of area, volume and arc length of various complicated geometry figures and their intersections in the first and second part of the treatise.

The *kaifang shu* 開方術 can solve the problem of extracting the roots of polynomial equations such as $a=a_1x+a_2x^2+a_3x^3+\dots+anx^n$. Koide moved forward a single step, apparently by analogy, to deal with the problem of

finding the root of the equation of the form $a=a_1x+a_2x^2+a_3x^3+\dots+anx^n+\dots$ which he called *kaiho meishiki* 開方漢式. He constructed three tables by which he could write the root x of $a=a_1x+a_2x^2+a_3x^3+\dots+anx^n+\dots$ as a power expansion of a . Eventually, he found out an approximate solution of the equation. Moreover, he also used these tables to solve problems of the *Yenri sankyo*.

Traditionally, *wasan* practitioners were deeply interested in the problem of expressing the arc length in terms of the diameter and the chord in a circle. Koide was no exceptional at this point. However, he also turned around the problem by trying to express the chord in terms of the arc length and the diameter in a form of a power series with the previously mentioned numerical tables. This presentation will be devoted to analyzing the content of the *Yenri sankyo* and how Koide's construction of these tables meant in the context of *wasan* on the eve of the Meiji Restoration.

Young Sook OH | Seoul National University, Korea, Republic of

A new explanation of the Ceyuan haijing (測圓海鏡) in nineteenth-century Korea

Based on a nineteenth-century Korean mathematical text, *Explanation of the detailed sketches in Ceyuan haijing* 測圓海鏡 (*Haekyōng sech'ohae* 海鏡細草解), this paper examines why and how the author Nam Pyōng-ch'ōl 南秉哲 (1817-1863) interpreted the thirteenth-century Chinese mathematical text *Ceyuan haijing*. He criticized the former researchers or commentators on the *Ceyuan haijing* for neglecting the 'sketch' (*cao* 草) part and provided a new explanation of the 'sketch' part, which was originally full of specific numerical values, with more general formulaic expressions. His new explanation will be analyzed at three levels. First, what terminology and mathematical contents are included, and whether these are consistent. Second, how the explanation interacts with the main Chinese text, and what role it plays. Last, how the explanation correlates with the other Korean mathematical texts at that time, and what features of the nineteenth-century Korean mathematical context it can be said to reflect. For the last analysis, it will be helpful to compare Nam's text with the Chinese Li Rui's 李銳 (1769-1817) commentary added into *Ceyuan haijing* in *Siku quanshu* 四庫全書 during his editing. Also this comparison will show the similarities and differences between Korean and Chinese mathematicians' attitudes to *tianyuan shu* 天元術.

T156. Topics in the history of modern mathematics

Sat 27 July, 16:10–16:55 ▪ Uni Place 4.212

T156-A. Modern mathematical institutions

Sat 27 July, 09:10–10:40 ▪ Uni Place 4.212

Chair: Marcia H. M. FERRAZ | Pontifícia Universidade Católica de São Paulo, Brazil

Mônica de Cássia SIQUEIRA MARTINES | Universidade Federal do Triângulo Mineiro, Brazil

O Doutorado em Ciências Matemáticas no Brasil: uma introdução

O objetivo desse trabalho é apresentar a institucionalização do doutorado em Ciências Matemáticas no Brasil, em meados do século XIX, tomando como referencial a carta de lei de criação da Academia Real Militar e os decretos de 1832, 1833, 1835, 1839, 1842 que alteraram o nome dessa escola e lhe deram novos estatutos ao longo dos anos. Ao iniciar a leitura dos documentos originais que tratam da instalação e das reformas da Academia Real Militar, notamos que uma das intenções de sua criação na cidade do Rio de Janeiro, no início do século XIX, era a de formar engenheiros militares com especial conhecimento matemático. Esperava-se destes engenheiros, que pudessem além de defender o País, fossem capazes de construir ruas, praças, pontes, administrar os gastos públicos, fazer orçamentos, construir mapas, abrir estradas, etc. Para garantir a formação desejada o então Ministro de Guerra elaborou os estatutos da Academia Real Militar adotando os mesmos livros didáticos que estavam sendo usados nas escolas Francesas, por constituírem os melhores da época para serem utilizados em escolas desse nível de ensino. Também estabeleceu que os professores dessa escola, deveriam escrever compêndios que tratassem das ciências pela qual era responsável, ressaltando a importância de os mesmos tomarem cuidado de irem adicionando aos seus compêndios as novas descobertas. Outro objetivo procurado desde a criação da Academia Real Militar era o de encontrar pessoas com habilidades em Matemática que pudessem ser inventores de ideias. Notando as dificuldades em formar engenheiros militares que também tivessem essa habilidade, no decreto nº 140 de 1842, cria-se o grau de doutor em Ciências Matemáticas no Brasil. Nessa época, para se tornar Doutor em Ciências Matemáticas no Brasil, foi exigido dos candidatos que tivessem sido aprovados no exame de seleção para o ingresso na escola, terem obtido aprovação plena em todas as disciplinas dos sete anos do curso completo, apresentarem uma tese sobre um assunto dos mais profundos das ciências ensinadas nos últimos três anos, apresentarem licença do diretor da escola e ter a tese aprovada por um dos professores da Escola Militar, o qual poderia ser escolhido pelo candidato e que não julgaria a tese pelo conteúdo, apenas reprovaria se houvesse algo que desonrasse ao Imperador ou a outra pessoa qualquer. Assim, em 1848 dá-se início as defesas das teses.

The PhD in mathematical sciences in Brazil: an introduction

The aim of this paper is to present the institutionalization of a doctorate in Mathematical Sciences in Brazil in the mid-nineteenth century, taking as reference the letter of the law creating the Royal Military Academy and the decrees of 1832, 1833, 1835, 1839 and 1842 which amended the name of the school and gave new statutes over the years. When you start reading the original documents dealing with the installation and reforms of the Royal Military Academy, noted that one of the intentions of its creation in the city of Rio de Janeiro, in the early nineteenth century, was to train military engineers with special mathematical knowledge. It was hoped these engineers, they could besides defending the country, they were able to build streets, squares, bridges, manage public spending, budget, build maps, open roads, etc. To ensure the desired training then Minister of War drafted the statutes of the Royal Military Academy adopting the same textbooks that were being used in schools French, because they constitute the best of time for use in schools on this level. It also established that the teachers of this school should write textbooks that treat science in which he was responsible, emphasizing the importance of taking care of them go to their compendia adding new discoveries. Another objective sought since the creation of the Royal Military Academy was to find people with skills in mathematics that could be inventor's ideas. We were noting the difficulty in forming military engineers who also have this ability, in decree nº140 of 1842, establishing the degree of Doctor of Mathematical Sciences in

Brazil. At that time, to become Doctor of Mathematical Sciences in Brazil, was required of candidates who had passed the selection test for admission in school, having obtained full approval in all disciplines of the seven years of full course, submitting a thesis on a matter of the deepest sciences taught in the past three years, submit license of the school principal and take the view adopted by one of the teachers of the Military School, which could be chosen by the candidate and who would not judge the thesis for the content, just flunked if there was something that dishonored the Emperor or any other person. Thus, in 1848 are initiated defenses of theses.

Viviane DE OLIVEIRA SANTOS | Universidade Federal de Alagoas, Brazil

Sociedade Brasileira de Matemática: Um estudo histórico e institucional

O tema sugerido neste projeto situa-se dentro de uma linha de pesquisa contemporânea na área de historiografia da Matemática: a *História da Matemática no Brasil*. Esta linha científica caracteriza-se pela análise da História da Matemática no país, proporcionando a observação do desenvolvimento local da Matemática, permitindo com isso, mensurar a importância da Matemática no contexto do desenvolvimento brasileiro.

Os aspectos sociais foram sendo inseridos ao longo do tempo aos estudos da História da Matemática, objetivando mensurar a importância do ensino no desenvolver econômico e intelectual do Brasil. No presente trabalho, queremos identificar o impacto na expansão da Matemática no país, a partir da criação da Sociedade Brasileira de Matemática, qual sua contribuição e importância neste contexto social.

A Sociedade Brasileira de Matemática (SBM), fundada em 1969, durante a realização do 7º Colóquio Brasileiro de Matemática, em Poços de Caldas, Minas Gerais, é uma entidade civil, de caráter cultural e sem fins lucrativos, voltada principalmente a estimular o desenvolvimento da pesquisa e do ensino da Matemática no Brasil. Entre suas ações atuais destacam-se: o estímulo ao ensino de qualidade em todos os níveis, através da produção e divulgação de textos matemáticos; a publicação de periódicos; a promoção de reuniões científicas; a organização da comunidade matemática para melhor atuar em prol do desenvolvimento da Matemática no país e o incentivo ao intercâmbio entre profissionais de Matemática do Brasil e do exterior.

Pretendemos com o trabalho, identificar a importância dessa instituição para o desenvolvimento e organização da Matemática e da comunidade matemática no Brasil; apontar as pessoas fundamentais na criação dessa Sociedade e em sua organização no período de 1969 a 1989 e investigar o estudo histórico da criação, das atividades, das publicações dessa Sociedade, bem como das pessoas envolvidas com ela em suas duas primeiras décadas de existência.

The Brazilian Mathematical Society: a historical and institutional study

The suggested theme in this project is situated within a line of contemporary research in the area of historiography of mathematics: the History of Mathematics in Brazil. This scientific line is characterized by analysis of the history of mathematics in the country in order to observe the local development of mathematics, allowing thereby measure the importance of mathematics in the context of Brazilian development.

The social aspects were being inserted along the time in the studies of the History of Mathematics, aiming to measure the importance of education in economic and intellectual development of Brazil. In this paper, we want to identify the impact from the creation of the Brazilian Mathematical Society on the expansion of Mathematics in the country, which their contribution and importance in this social context.

The Brazilian Mathematical Society (SBM) is a civic, cultural and nonprofit entity, founded in 1969, during the 7th Brazilian Mathematics Colloquium, in Pocos de Caldas, Minas Gerais. It is mainly focused into stimulate the development of the research and teaching of mathematics in Brazil. Among its current actions are: to stimulate the quality education at all levels, through the production and propagation of mathematical texts, the publication of periodicals; organization of scientific meetings, the organization of the mathematical community to better act in favor development of mathematics in country and encouraging the exchange between professionals of Mathematics in Brazil and abroad.

In this work, we intend to identify the importance of this institution for the development and organization of Mathematics and mathematical community in Brazil; to recognize fundamental people in the creation of this society and its organization in the period from 1969 to 1989, and to investigate the historical study of creation, activities and publications of this Society, as well of as the people involved with it in its first two decades of existence.

Zdzisław POGODA | Jagiellonian University, Poland

Some remarks about Cracow mathematical school before World War II

In 1918 Poland became again an independent country. This was a good point for a remarkable development of science. Great mathematical centres were created in Lwów (with Banach, Steinhaus and Mazur) and Warszawa (with Sierpiński, Mazurkiewicz and Kuratowski). Nevertheless, Kraków was also very important to Polish mathematics. Zaremba and Żorawski played the main role in mathematics at the Jagiellonian University. Several young outstanding mathematicians, educated in Kraków, joined mathematical staff at the Jagiellonian University, particularly Franciszek Leja, Tadeusz Ważewski, Witold Wilkosz and Stanisław Gołąb. Teaching mathematics appeared to be at remarkably high level. Mathematically, Kraków represented first of all mathematical analysis and related areas, especially differential equations, but several other advanced courses were also organized, for example on topology, geometry, number theory, algebra. In particular, there were courses on algebraic functions, Hilbert spaces and Riemann surfaces. Also, many topics concerning different applications of mathematics were lectured. Among mathematicians who delivered mathematical courses for shorter period of time were also Jerzy Splawa-Neyman and Otton Nikodym. It should be noted that before World War II the results of Kraków mathematicians were so respected in the mathematical world, that several of them were invited speakers at International Congresses of Mathematicians. Polish mathematics was struck very strongly during World War II. It was also the case of Kraków mathematicians.

T156-B. Biographies and contexts in history of maths

Sat 27 July, 11:10–12:40 • Uni Place 4.212

Chair: Jochen F MAYER | University of Edinburgh, United Kingdom

Galina SINKEVICH | St Petersburg Architectural Building University, Russia

Georg Cantor and Russia

Georg Cantor was born in St. Petersburg in 1845 to a family of a merchant, George Woldemar Cantor, and Marie Böhm -Cantor, daughter of Franz Böhm, St. Petersburg violinist, the best virtuosic soloist at St. Petersburg theaters.

Georg Cantor was born house 24 in the 11th line of Vasilevsky Island in Petersburg, attended Petrischule at the Lutheran Church of St. Peter. Members of their extended family belonged to the academic, court, artistic and commercial circles of St. Petersburg. There were eight violinists in the family, two court younger ladies (cameryoungfrau), a head waiter, a university professor, a professor of the Conservatory, an artist, and merchants. Georg Cantor played the violin and loved music and St. Petersburg all his life. The family moved to Germany when Georg Cantor was 11 years old.

As an adult, when creating his own set-theoretic work, Cantor repeatedly appealed to musical images. Moreover, those were musical images that helped him in 1872 to feel the lack of an irrational number as a limit when defining arithmetic continuity, and introduce the principle of one-to-one correspondence as a fundamental to his theory.

Many mathematicians were pondering on the continuum arithmetization problem and the number conception. Those were Charles Measure (1869, 1872), Karl Weierstrass, Edward Heine (1872), Cantor (1872) and Dedekind (1872). The arguments were based on the convergent series. Dedekind (son of a lawyer) gave a perfect legal definition of a number (1872), but these approaches did not make it possible to estimate the amount of numbers in general and in particular, the irrational numbers. The Set Theory, created by Cantor in the eighties, contained a scale of infinities that helped introduce the comparison of sets of power. This association was only possible with a rich cultural and musical basis in Cantor's researches.

Cantor's work attracted interest in Russia. In 1902, P. Florensky issued a statement of Cantor's ideas. In 1907, I.Zhegalkin made a presentation on the theory of sets (Transfinite numbers) at Moscow State University. In 1908, A.Vasilev published some Cantor's works translated by P.S.Yushkevich. The researches of the Moscow school of function theory were headed by Egorov and Luzin and based on the set theory.

Galina ZVERKINA | Moscow State University of Railway Engineering (MIIT), Russia

Kirik Novgorodets (Kirik the Novgorodian): a Russian mathematician of the twelfth century

Kirik Novgorodets was the monk and the regent of church chorus in a monastery founded by St. Anthony of Rome in Novgorod the Great, later he was a deacon, the priest and the important person in retinue of Nifont, the archbishop of Novgorod the Great. Kirik Novgorodets was born in 1110 and he has died after 1156/58. We know two compositions of Kirik: it is "The Questions of Kirik" ("Вопрошания Кирика, иже вопросы епископа Нифонта и инех") and "Manual about numbers" («Кирика диакона и domestика новгородского Антоньева монастыря учение им же ведати человеку числа всех лет»). "The Questions" are devoted discussion of difficult situations in practice of the Novgorod orthodox church; some centuries this text was a component of the orthodox initial right. In this text of Kirik we can see the information on a daily life of Novgorodians. For example, in this text the Novgorod birch bark manuscripts are mentioned (they have been found by archeologists only in 1951). However for history of science "Manual about numbers" is more interesting. In this text Kirik calculated quantity of months, weeks, days and hours which have passed from Creation of the World. He shows ability to make arithmetic operations with very big numbers; probably, he was the author of special designations for such numbers. Also Kirik specifies the least particle of time (about 0.04608 seconds); this value can be received only as a result of experiment. Really, there is a minimum particle of time distinguishable by person and possible in a piece of music. (Similar division of time in the Western Europe and in Byzantium was more inexact.) Thus Kirik used equinoctial hours, it was atypical in the Middle Ages: during this period day or night hour was equalled the one twelfth part of light or dark time of day. Besides, Kirik has offered idea about renewal of four elements of Nature and about periodicity of these renewals; similar ideas were unknown in the Western Europe. Also in compositions of Kirik it is possible to see interest to astrology. In Novgorod the Great the majority of people were able to

read and write; in 1030 there Grand Prince Yaroslav the Wise has founded school for teaching to the bookness (книжность). The city had numerous connections with the East and West countries, monasteries and rich people owned the big libraries. Kirik Novgorodets has read many western and Byzantian books. He knew mathematics, astronomy, history, theology, philosophy, music and, probably, medicine.

BACHA Maria de Lourdes | Universidade Presbiteriana Mackenzie, Brazil

Peirce and Cantor: about the continuum and infinitesimals

This article aims at analyzing some topics related to the continuum and infinitesimals in the writings of Charles Sanders Peirce (1839-1914) and George Cantor (1845-1948). As for relevance, both Peirce and Cantor belong to the group of mathematicians that have studied the subject. The context can be taken into account from three different points of view: historical, philosophical, and mathematical. This study is restricted to the second half of the 19th century as well as the first two decades of the 20th century. On one hand, it is worth mentioning that Mathematics had developed significantly in Europe at that time. Regarding Cantor's contributions, in Halle, Germany, the following can be highlighted: texts on real number (1872), disclosure of the Cantorian theory (1895-1897), formulation of the enumerable and continuum concepts (1874), the introduction of the concept of power (1878), study of the infinite, linear point sets (1879-1884). On the other hand, until 1880s, Science and Mathematics had remained underdeveloped in America with very few acknowledged contributions. Due to his findings regarding the set theory and mathematical logic, Peirce has stood out from his fellow European scientists. According to Belna (2011), Cantor spent his whole life explaining the continuum. It was first described in Grundlagen as a "perfect, one piece set" (Cantor, 1884, p. 208). Peirce became familiar with Cantor's work around 1883-84 (CP 3.563). In the Collected Papers alone there are thirty-two passages in which Peirce discusses the Cantorian theory. There is also information of two letters sent to Cantor. Peirce gets to the conclusion that true continuum is different from any metric or orderly relation of components, it does not consist of real components (CP 3.631), it is general and could not be defined as a set, a collection of different components as Cantor's definition (CP 4.640). According to Peirce, Cantor's definition of continuity is unsatisfactory as involving a vague reference to all the points (CP 6.125). Peirce's continuum implies infinitesimals. Cantor was against infinitesimals, solution that was only properly acknowledged later on after the development of non-standard analysis. Therefore, despite the fact that Peirce and Cantor have shared the same object of study, their styles and the origin of their approaches and philosophical ideas are different.

Gabriela BESLER | University of Silesia, Poland

Gottlob Frege on number: the development of his conception, 1879-1925

Gottlob Frege was a German mathematician, logician and philosopher who influenced the shape of 20th century analytical philosophy. The main philosophical problem investigated by him was the question: *What is a number?* He maintained that the question is a common problem for mathematicians and philosophers. Frege worked out some ways of defining a number. Although Frege's conception of number has already been described quite well I would like to show his achievement from other point of view, and pay special attention to the following problems:

1. The development of Frege's conceptions of number.
2. The reasons why he kept looking for a better conception.
3. His logical, semantic and philosophical tools used to present the definition of number.

I shall stress the considerable differences between some expressions on number based on differences in:

1. using primitive terms.

2. accepting assumed philosophical background.

I will try to highlight the differences and work on assumption that there are three original and different conceptions of number in his papers:

1. The inductive definition: *Begriffsschrift* 1879, *Anwendung der Begriffsschrift* 1879; *Die Grundlagen der Arithmetik* 1884.

"a" is a positive whole number when "a" belongs to the sequence which begins with 0 and arises from a constant increase by 1 (*Anwendung der Begriffsschrift*);

the number [Zahl] $(n+1)$ belongs to a concept F , if there is an object a falling under F and such that the number [Zahl] n belongs to the concept "falling under F , but not a" (*Die Grundlagen der Arithmetik*, § 55).

2. The definition by equinumerosity: *Die Grundlagen der Arithmetik* 1884; *Grundgesetze der Arithmetik*, vol. I, II 1893, 1903; *Nachwort* added to II vo. of *Grundgesetze der Arithmetik* 1903.

The Number which belongs to the concept F is the extension of the concept "concept equal to the concept F " where a concept F is called equal to a concept G if there exists the possibility of one-one correlation referred to above *Die Grundlagen der Arithmetik*, § 107).

3. The definition based on geometry (unfinished): *Zahlen und Arithmetik* 1924/1925; *Neuer Versuch der Grundlegung der Arithmetik* 1924/1925; *Erkenntnisquellen der Mathematik und Naturwissenschaften*, 1924/1925.

The number that in this way defines the size of angle is the number yielded by measuring the arc of C included by its sides with the radius of C . [...] The number 1 defines an angle for which the length b [arc] is equal to r [radius] (*Erkenntnisquellen...*, 1924/1925).

T156-C. Nineteenth- and twentieth-century mathematics

Sat 27 July, 14:10–15:40 ▪ Uni Place 4.212

Chair: Elizabeth BRUTON | University of Leeds, United Kingdom

Wieslaw WÓJCIK | Polish Academy of Sciences, Poland

Hugo Steinhaus as a precursor and co-originator of recent game theory

Steinhaus played a significant part in building of the mathematical game theory. He was its precursor and co-originator. In 1925 he published the work *Definitions for a theory of games and pursuits* (in polish, „Myśl Akademicka”, pp. 13-14). The work was translated and published in *Naval Research Logistics Quarterly* in 1960 (no 7, pp. 105-108). He defined the idea of strategy (before John von Neumann, he called it as "mode of play") and developed the mathematical foundation of game theory and its application.

According to Steinhaus, the researches on game theory was connected with a trial of mathematization of probability theory. Until Steinhaus this theory hadn't been treated as a proper mathematical theory because of insufficient mathematical tools. In the sixth problem David Hilbert postulated an axiomatization of it as a method of its mathematization. In 1923 H. Steinhaus and A. Łomnicki published in „Fundamenta Mathematicae” two papers in which they demonstrated how we can take the measure theory as a foundation of probability theory. In paper *Les probabilités dénombrables et leur rapport à la théorie de la mesure* Steinhaus mathematized the « heads and tails » game. In that paper important tools became « independent functions ». Those ideas were generalized and developed in construction of probability based on concept of measure by A. Kolmogorov.

Some years later Steinhaus (with J. Mycielski) formulated the axiom of determinateness (*A mathematical axiom contradicting the axiom of choice*, 1962). Besides game theory it plays a significant role in researches of set theory. It implies the negation of the axiom of choice but, on the other hand, it gives possibilities of building a weaker version

of set theory (it allow to avoid problems connected with the use of the choice axiom).

Jochen F MAYER | University of Edinburgh, United Kingdom

On the 'mathematisation' of measurement in (West) German academic and official statistics around 1920-1950

This paper explores German statistical discourse at a crucial moment when, especially after 1945, mathematically trained statisticians increasingly challenged the authority of then dominant social and economic statistics. Drawing on archival material of the German Statistical Association's annual meetings and statistical textbooks, I argue that 'mathematisation' in statistics was a particular discourse in the language of contemporary statisticians. The first part of the paper utilises the idea of 'boundary disputes' (Gieryn 2001) to show how statisticians used the 'mathematisation' discourse to (re-)order knowledge within their discipline in *intellectual* (sampling theories, formulas) and *institutional* (education and training of statisticians) terms. Social statisticians (the 'Frankfurt School') defended their factual logic but struggled to keep their discipline 'pure' from advancements in probability theory. Mathematical statisticians (the 'Munich School'), by contrast, translated 'mathematisation' into matters of methodical proficiency with the aim of expanding the epistemic authority of their field.

The main part will focus on how 'mathematisation' played out differently with regard to measurement issues, their cognitive boundaries and to claims for statistical objectivity. I will show how 'Frankfurt' statisticians defended an autonomous space for the social world essentially demanding the *logical* definition of elements to be counted; their 'social arithmetic' involved *conceptual* work, similar to that in contemporary social sciences. Social statistics were seen as a method of mass observation essential for the study of society precisely because of the diversity of individuals. By contrast, for mathematically trained statisticians, 'mathematisation' first and foremost helped to demarcate a space for statistical practice based on probability calculus which, other than 'social arithmetic', served as a unifying, overarching perspective that could be applied infinitely to any research field. The mathematical language thus functioned as a formula to foster agreement among all those who had mastered its procedures while excluding all those who did not. This language – almost entirely incomprehensible to Frankfurt social statisticians – helped set *numerical* 'rules' that established when and how judgments could be made on the basis of partial or uncertain information; a matter for which 'Frankfurt' statisticians had nothing but their 'sure instincts'.

Danuta CIESIELSKA | Pedagogical University in Krakow, Poland

On mathematical papers in the *Bulletin international de l'Académie des sciences de Cracovie*

In 1872 the first Polish scientific academy (*Academy of Arts and Sciences*) was founded in Kraków. The Academy founded the first international journal *Bulletin International de l'Académie des Sciences de Cracovie* (*Anzeiger der Akademie der Wissenschaften in Krakau*), in which mathematical papers were published. In 1910 the journal was divided into classes and series – for mathematics it was: *Classe Des Sciences Mathématiques et Naturelles. Série A: Sciences Mathématiques*. From 1890 to 1952, when the Academy was disbanded, in the journal were published almost 400 mathematical papers. Among the authors were outstanding mathematicians: M. Fréchet, A.N. Kolmogorov, T. Levi-Civita, G. Polya, G.T. Whyburn and the Poles: S. Banach and W. Sierpiński.

I shall present basic statistical facts about the journal. Moreover, I will describe several papers important in the history of mathematics, which have been published in this journal, for example *On the Problem of Two*

Samples and On the Problem of k Samples by E. Pearson and J. Neyman.

T156-D. Problems in the history of maths in the long nineteenth century

Sat 27 July, 16:10–17:40 • Uni Place 4.212

Chair: BACHA Maria de Lourdes | Universidade Presbiteriana Mackenzie, Brazil

Aleksandra PETROVA | Saint-Petersburg State University of Architecture and Civil Engineering, Russia

The history of Euler's problem of vertical bar stability from the eighteenth to the twentieth century

In this article we'll consider the history of the vertical bar's loss of stability problem. Let some force directed along the bar's axis acts on vertical bar which height is greater than its cross section's length. It's necessary to find the value of this force, from which the bar will start to curve.

Before XVIII century such problems had been solved empirically. The first mathematical decision of this problem belongs to L. Euler. He derived a theoretic formula and considered its versions in case of different fixing ways.

Nevertheless Euler's formula works only for flexible bars and non-eccentric load. First it was found out by I. Hodgkinson, an English engineer and a member of Manchester's scientific community. Few later on a base of Hodgkinson's experience A.E.H. Love, an Oxford Professor, also derived an empirical formula. But its drawback is that there's no dependence of numeric coefficients on properties of the material in the formula.

In 1845, a Belgian engineer E. Lamarl first set a limit to applicability of the Euler's formula. He offered to take the critical tension of flexible bars to be equal to yield limit. Subsequently, the Euler's theory of stability was tested in the experiences of J. Bauschinger and L. Tetmajer. Bauschinger, a German engineer, worked at this problem in the Munich Polytechnic laboratory. As a result of the test Bauschinger found out that because of different errors the sample was starting to curve at the small value of compressing force. This value is very close to the critical one, computed by Euler in condition that tension, conformed to this force, is less than the proportional limit at compressing.

In 1890 L.von Tetmajer, a Professor of Polytechnikum in Zurich, made experiments at stability of compressed iron bars with different cross sections. In 1889 F. Engesser, a German engineer, offered to compute a critical tension by Euler's formula having changed an elastic modulus by tangential modulus. Experimental definition of critical forces for compressed bars was made repeatedly.

The most comprehensive material was compiled by F. Jasinski. He initiated the modern methods of computing the compressed bars stability. F. Jasinski was a Professor at the Saint-Petersburg Institute of Civil Engineers. In 1895 Jasinski and Tetmajer, on a base of experimental knowledge offered an empirical linear formula for computing the critical tensions.

Nowadays, attempts at theoretic solution of this problem are continuing.

TAJIMA Toru | Osaka Univ., Japan

Ballistic theory before Benjamin Robins and Leonhard Euler in the seventeenth and the first half of the eighteenth century

In my research, below point of view has an important state, that is the complement to the traditional view of conflicted historiography of physico-mathematics in 17th-18th century Europe. We have also already known very typical cases of conflicts, for example Newton and Leibniz's priority race on the discovery of calculus, Barkley and Continental

mathematicians Discussion over the existence and utilization of infinitesimal small quantity, etc.

Is there any other way in order to represent a new historiography of 18th century?

Main appropriate material is an example that can express the reception and exchange of knowledge in this era, c'est-a-dire: ballistics problem. There are some possibilities to contribute to my attempt for building new historiography in this domain. And my study does not only concerned history of the exact science but also more general situation of Central Europe till the half of 18th century: military, state, mathematician, transition of new devices etc.

On the theory of ballistics in the middle of 18th Century, we have already so many prior researches including B. Robins and L. Euler. But further past research should be expanded so as to comprehend the total situation in these two centuries and the origin of ballistics revolution. Therefore, I emphasize here the French tradition which had the strongest army in this era and I especially analyze several talented researchers.

At first, François Blondel was an important practical and theoretical engineer situated in the last position of pre-Newtonian age and I treat his work. Secondly, Jacques Cassini who is the son of Giovanni Domenico Cassini, successor of Observatoire de Paris, tried to make a new instrument for measuring ballistic nozzle speed. Last person is a well-known savant, Pierre Varignon who had acquired old and new kinematics and mathematics. Can we find any indications of the ballistic revolution in this pre-phase and make a few modifications on ordinary conflicted historiography?

T157. Pre-modern astronomy and cosmology

Sat 27 July, 09:00–15:30 ▪ Roscoe 2.2

T157-A. Early astronomical contexts

Sat 27 July, 09:00–10:30 ▪ Roscoe 2.2

Chair: Seb FALK | University of Cambridge, United Kingdom

JESUDASAN Samuel Cornelius | Madras Christian College (Retired), India

Mean motions in Indian astronomy

Mean motions in Indian astronomy

J. Samuel Cornelius (Retired)

Madras Christian College, Chennai – 600059, India

This article is a follow-up of a very important contribution to the understanding of Indian astronomy by Roger Billard who has calculated the mean longitudes of the sun, moon, moon's apogee and node, and those of the five known planets, from the numerical data in the main astronomical texts. The errors of these longitudes are determined by comparing them with the results of the modern formulae.

Billard uses the methods of mathematical statistics to find the most probable dates of the observations. His graphs, in which the errors of the longitudes are plotted against time from BC 500 to AD 1900, illustrate his most important conclusions. For example, the Aryabhata graph shows that he made accurate observations at about AD 510. There are large errors on earlier and later dates, showing that the rate of change of longitudes, the mean motions, are far from correct.

Another important result of Billard's, investigation is the dating of the Maha-siddhanta which Billard finds to be in the sixteenth century, contradicting the earlier estimate of Dikshit of near AD 980. Billard's

dating has been strongly supported by an independent study of Raymond Mercier.

Billard finds that amongst the Indian astronomers, Lalla gets a much better accuracy than Ptolemy's method. Later the sixteenth-century astronomer Nilakantha Somayaji gave computations that were comparable to Lalla's in accuracy.

In this paper we follow up Billard's conclusions by investigating mean motions, instead of mean longitudes as was done by Billard.

To get a historical perspective we go back to the Babylonian records. Using a statistical measure of error, the mean values of Babylonian and Ptolemy's errors are computed and compared. Ptolemy is about three times more accurate.

A similar exercise is done, to calculate the errors of the mean lunar and planetary motions of Ptolemy and the most prominent Indian astronomers, Aryabhata, Brahamagupta, Lalla, Nilakantha Somayaji and seven other Indian Canons. We compare the accuracy of planetary motions of Ptolemy and the Indian astronomers in this paper. We also compare the accuracy of lunar motions of Ptolemy and the Indian astronomers.

Mahesh K | Samskrit Promotion Foundation, India

Considering the effect of parallax: the Indian and the Chinese approach

It is well known that the effect of the parallax is to increase in the apparent zenith distance of a celestial object. Unless we consider its effect into account, the predictions can go wrong considerably, particularly in the case of eclipses. Since the obscurer and the obscured at the same distance in the case of a lunar eclipse, the effect of parallax can be completely ignored. However, in the case of solar eclipse, parallax significantly influences the precision with which we can predict the instant of opposition, the duration of the eclipse, as well as its magnitude.

Clearly recognizing this fact, the astronomers of both Indian and Chinese tradition have paid enough attention to consider its effect into their computational scheme. In the Indian tradition, the astronomers have broadly divided the effect of parallax in two parts namely the parallax in longitude (called *lambana*) and the parallax in latitude (called *nati*). Whereas in the Chinese tradition, the effect of parallax seems to have been discussed in three parts: Qi difference, Ke difference and Time difference. The first two are also referred to as the north-south difference and the east-west difference respectively. During our presentation, we will try to compare and contrast the approach taken by the two traditions in handling the effect of parallax in computing solar eclipses.

Ki-Won LEE | Catholic University of Daegu, Korea, Republic of

MiHN Byeong-Hee | Korea Astronomy and Space Science Institute, Korea, Republic of

AHN Young Sook | Korea Astronomy and Space Science Institute, Korea, Republic of

The measurement of sunrise and sunset times in Chiljeongsan-Naepyeon

Chiljeongsan-Naepyeon (七政算內篇; hereafter, Naepyeon) is a type of astronomical calendar that was used by the Joseon dynasty of Korea.

The book of Naepyeon, compiled by Yi, Sunji (李純之) and Kim, Dam (金淡) in 1442, lists the times of sunrise and sunset at Hanyang (漢陽; the capital of the dynasty, which is present-day Seoul). The listed times have very high accuracies, approximately less than or equal to 1 min, compared with the accuracy of the calendar itself. Naepyeon is known to be fundamentally the same as Sushili (授時曆), which was made by

Guo Su-Jing (郭守敬) in the Yuan dynasty or Datongli (大統曆) in the Ming dynasty of China. Sushili is currently evaluated as one of the best

calendars throughout the history of the Chinese calendar. In this work, we study the times of sunrise and sunset in Naepyeon. First, we investigate the measurement procedures used to obtain the sunrise and sunset times in Sushili, referring to Yuanshi (元史; the history of the Yuan dynasty) and Mingshi (明史; history of the Ming dynasty). Then, we reproduce the times of sunrise and sunset at Beijing given in the literature. We found that various mathematical methods - Hushigeyuan (弧矢割圓; an approximation method for calculating an arc) and Zhaochafa (招差法, an interpolation method using a cubic equation), which includes the Pythagorean theorem - were used in Sushili to measure those times, together with observational data - the latitude and obliquity of the ecliptic, which were derived from the shadow lengths of the Guibiao (圭表; gnomon) on the summer and winter solstices. Finally, we calculate the times of sunrise and sunset according to the latitude based on the measurement procedures in Sushili and estimate the latitude used in Naepyeon by comparing the results of our calculations with the times presented in the book of Naepyeon.

T157-B. Astronomy and instruments in Asian contexts

Sat 27 July, 11:00–12:30 ▪ Roscoe 2.2

Chair: Emily WINTERBURN | University of Leeds, United Kingdom

LEE Yong Bok | Seoul National University of Education, Korea, Republic of

The structure and application of scaphe sundials used in the Joseon Dynasty, 1392-1910

Many kinds of astronomical Instruments were made and used in early Joseon Dynasty, which are the Striking Clepsydra, Time-Determining Instrument by the Sun and Stars, Simplified Instrument, Gnomon, Armillary Sphere, Celestial Globe, Scaphe Sundial, Plummet Sundial, and so on. There are over fifteen kinds.

Especially Scaphe Sundial was made of bronze which shape is hemisphere. It was invented in AD 1434 during the King Sejong's Reign. It has been used as a public clock as well as time keeping system for astronomer during Joseon Dynasty (1392-1910). The sundial can be easily find the time and season of the day from the tip of gnomon's shadow on the circles of concave surface. Though the diameter of the hemisphere is about 35 cm, the reading accuracy for time is within five minutes, and for the season within five days.

The Sundial shows a lot of informations on the Sun's position as well as time and season. They are the Sun's azimuth and altitude, the direction of sunrise and sunset, and the duration of daytime on the day in the year. It is possible to estimate the seasonal change and the Sun's path on the sky in each season.

Astronomers and Confucian scholars during Joseon Dynasty understood the motion of heavenly bodies included the Sun and Moon, and cosmological idea from the sundial. The function of the sundial during the period has a clock and calendar as well as a instrument for astronomical purpose. Especially it shows clearly the relation between equatorial and horizontal coordinate system.

KIM Sang Hyuk | Korea Astronomy and Space Institute, Korea, Republic of

An analysis of the time signal system of Song I-Yeong's armillary clock

Song I-Yeong (1619–1692), who is astronomy professor of *Gwansanggam* (bureau of astronomy), made armillary clock in 1669 (10th year of king *Hyunjong* era). Armillary clock is a unique astronomical clock which combines armillary sphere, traditional astronomical instrument of Far Eastern, with the power mechanism of Western alarm

clock. The clockwork part of this clock are composed of the going train, which is a power unit used the weight, and the time signal system in a wooden case. Also, the time signal system are composed the time-annunciator, strike-release ball-system, and striking train and displays the time by 12 different time signal cards and sound of bell. This clock has been shut down because of several components have been lost. This study is for understanding the working mechanism of each units and suggests its restoration process.

LIN Hsiao-Chien | Institute of History, National Tsing-Hua University, Taiwan, Taiwan

Why did Zheng He choose the qianxingban (牽星板) as the navigation tool for his voyages?

In the early 15th century, the famous Chinese naval commander Zheng He 鄭和 (Cheng Ho, 1371-1433) conducted seven expeditions to Java, Sumatra, Malacca, Aden, Hormuz, Mogadishu, and sailed as far as the East coast of Africa to visit the Red Sea and Mecca. It is known that for navigation Zheng He used, besides a compass, a particular instrument named *qianxing ban* 牽星板. The extant descriptions of this instrument mention twelve square boards of different sizes used to identify the location of the ship in the ocean on the basis of observations of stars at night. It is also known that during the Song dynasty (960-1279) another instrument named *liangtian chi* 量天尺 was used in China for the same purpose. This was an instrument including a ruler with marked scales used to measure the sun's shadow and positions of the stars.

Why did Zheng He prefer to use the *qianxing ban* rather than the *liangtian chi*? Did he do so because the *qianxing ban* was superior to the latter, or for some other reasons? To answer this question it is necessary to reconstruct both instruments and then to compare them.

Attempts to reconstruct these two instruments have been made by several scholars, for example, by Wang Lixing 王立興 and Yan Dunjie 嚴敦杰. In my paper I will critically evaluate their reconstructions, revisit the primary materials used by these two authors, and then propose my own reconstruction. In particular, I will explore the hypothesis of an Islamic origin of the *qianxing ban* used by Zheng He, since it is known that Zheng He was a Chinese Muslim and may thus have had strong connections with Islamic culture.

MIHN Byeong-Hee | Korea Astronomy and Space Science Institute, Korea, Republic of

AHN Young Sook | Korea Astronomy and Space Science Institute, Korea, Republic of

On the ring graduations of compact astronomical instruments invented in the early Joseon dynasty

During the reign of King Sejong (1418 – 1450) of the Joseon dynasty, several compact astronomical instruments such as So-ganui (小簡儀, small simplified armillary sphere), Ilseongjeongsui (日星定時儀, sun-and-stars time-determining instrument), Hyeonju-ilgu (懸珠日晷, plummet equatorial sundial), Jeongnam-ilgu (정남일구, south-fixing armillary sundial) and so forth were invented. It is considered that those instruments were made on the basis of the know-how to manufacture Honcheonui (渾天儀, armillary sphere), Honsang (渾象, celestial globe), Ganui (簡儀, Simplified armillary sphere), and Gyupyo (圭表, Gnomon) which were originated from the Song or Yuan dynasty of China. Meanwhile, astronomers of the latter and the Joseon dynasty divided the celestial equator (a celestial-circumference) and a day into 365.25 degrees and 100 intervals, respectively. The rings engraved the graduations for the celestial equator and the day were called Juchedobun-hwan (周天度分還, celestial-circumference degrees ring) and Baekgak-hwan (百刻還, hundred-interval ring), respectively. In this paper, we investigate of ring graduations of compact astronomical instruments produced in the King Sejong's era. As a result, we found that ring graduations were marked as the integer times of Bun (分,

fraction), a length unit. For example, 1 degree corresponds to 1 fraction in the graduations of the celestial-circumference and hundred-interval rings with the diameters of 1.16 and 0.32 Cheok (尺, foot), respectively. We think that the same manner was applied to other compact astronomical instruments such as Jeongnam-ilgu, etc. In conclusion, we think that this study will be useful for reconstructing those sundials.

T157-C. Astronomy: techniques of the east and west

Sat 27 July, 14:00–15:30 ▪ Roscoe 2.2

Chair: Christopher CULLEN | Needham Research Institute, United Kingdom

Yong Li | National Astronomical Observatories, China

Solar meridian observation in ancient China

In China by use of an erecting pole to measure the shadows of the sun has a long history as usually to derive the time of solar terms. We investigate three historical documents, the *Zhoubi Suanjing*, one of the most important ancient Chinese books on mathematical astronomy, was compiled about 100 BC and the *Shoushi Liyi* compiled in 1279, an ancient treatise for reviewing *Shoushi Li* calendar and the book *Wushen Lichun Kaozheng* compiled in 1608. Some conclusions are obtained that at latest in BC 560 the Chinese people had launched this method to measure the shadows of the sun, and suggested the incorrect law of ‘*cun qian li*’, which says the shadow length of a gnomon of 8 *chi* (about 1.96 m) high will increase (or decrease) 1 *cun* (1/10 *chi*) for every 1000 *li* (roughly 400 km) the gnomon moves northward (or southward). The ancient method to get the time of solar terms is not accurate enough, as also not supported by modern astronomy. The time of winter solstice obtained usually as a most fundamental data for every ancient calendar. The height of the pole had increased from 8 *chi* to 60 *chi*, but the accuracy is not increased enough, as usually not better than 1’.

Mohd Saiful Anwar MOHD NAWAWI | University of Malaya, Malaysia

Behind the scenes: the Islamic calendar in Malaysia

Expected visibility (imkan al-rukyah) criterion has been applied to determine the beginning month of Islamic calendar in Malaysia since 1984. This paper aims to investigate chronologically the process behind the decision which was taken to formulate the criterion. It shall provide an analysis of official documents and interviews and followed by a general overview of the development of such criterion in Malaysia. From the point of its astronomical backgrounds the author suggest that this criterion was adopted from the Istanbul Resolution 1978 and formulated based on the reports of moon sighting produced by the Indonesian religious authorities.

SUN Xiaochun | Institute for the History of Natural Science, Chinese Academy of Sciences, China

The star maps in *Xin Yi Xiang Fa Yao*

Xin Yi Xiang Fa Yao is a book that records the shape and principle of operation of the large astronomical instrument water-powered astronomical clock tower in the Northern Song Dynasty, divided into three volumes. There are five star charts in the volumes (two horizontal charts and three cover charts). As recorded in *Xin Yi Xiang Fa Yao*: water-powered astronomical clock tower was built in the Northern Song Dynasty, and was a large-scale astronomical instrument set up under the directing of Su Song and Han Gonglian. It is a square wood structure building that is narrow on the top and broad at the bottom and the armillary sphere etc are made of copper. The entire tower is divided into three compartments, and the under compartment includes a timekeeping device and actuating unit of the entire tower etc; the middle

compartment is a secret room for storing armillary sphere; the upper compartment is a board house, which stores the armillary sphere. This topic focuses on the armillary sphere star chart of the water-powered astronomical clock tower. According to the existing materials, only five star charts in the *Xin Yi Xiang Fa Yao* can be used as the most intuitive data for studying the armillary sphere star chart. There are no related star tables and data come down. Through analyzing and comparing the star charts of the existing several versions of *Xin Yi Xiang Fa Yao*, mainly include Complete Library in Four Branches of Literature, Series Integration, Universal Libraries, Ningbo Tianyi Pavilion Collection Shoushan Pavilion Series, Nanjing Library Collection Holding *Yi Xiang Fa* Compiled Version, the Series Integration is selected as the star chart version that is most suitable for analyzing the star position. Finally, according to the precession theory of modern astronomy, use the celestial precession nutation P03 model issued by the IAU International Astronomical Union to calculate the historical right ascension and declination data of star described in the star chart, choose the determinative star of each star in the horizontal chart as the study sample, calculate the celestial coordinate data of the star sample in this star chart from AD 600 to AD 2000 under Matlab 2009 matrix laboratory platform calculate the average deviation and standard deviation values of the sample by comparing this sample data and measurement data of the star chart. By combining the statistic analysis, predict the accuracy and observation years of the star position, and draw the conclusion that the observation years of the stars drawn according to the star chart of the *Xin Yi Xiang Fa Yao* are the Yuanfeng reign of the Northern Song Dynasty.

This presentation is based on work co-authored by Guoqiang Li.

Seb FALK | University of Cambridge, United Kingdom

Putting classical astronomy to work: the design and use of a medieval equatorium

Developed in the Islamic world from the eleventh century CE and refined in western Europe between the thirteenth and sixteenth centuries, equatoria were material instantiations of the principles of Ptolemaic planetary astronomy. Although they are often categorised as astronomical instruments akin to the more familiar astrolabes, they represented a more complex planetary science: they were not normally used for observation but functioned either as computers or demonstration devices: either simplifying astronomical theories for practical solutions or providing manipulable diagrams for educational purposes.

Few equatoria survive; most are known from treatises that describe their manufacture and use. Among the best known of these is an almost complete fourteenth-century work that survives in a single manuscript copy, bound with a set of astronomical tables modelled on the thirteenth-century Alphonsine Tables. The manuscript was first studied and named *The Equatorie of the Planetis* by Derek de Solla Price, who attributed it to Geoffrey Chaucer, but its provenance cannot be known with certainty.

What is clear is that its author was an accomplished practical astronomer: he was able to manipulate Ptolemaic principles to produce an instrument of impressive clarity and usability: a single large disc, open ring, moving pointer and set of threads allow the calculation of the locations of the sun, moon and planets with great accuracy. The theories have been pared down to ensure that this calculator is relatively simple to produce and still easier to use, saving its user a great deal of time that would otherwise be taken to compute planetary positions geometrically.

I will explain how the author improved upon earlier simplifications such as the ‘epicycle tail’ model to produce an instrument that, while not without its limitations, provides an outstanding balance of simplicity and accuracy. I will argue that, though it would be unwieldy, the instrument described in the manuscript was certainly designed to be made, and was not simply a thought experiment; I will use a model I have constructed according to the instructions in the manuscript to show this. This

assemblage would not have served particularly well to demonstrate Ptolemaic principles; what it was was an intensely user-friendly computing device. I will discuss the various purposes to which it might have been put.

T158. Knowledge and experiment in natural philosophy

Fri 26 July, 09:10–15:40 ▪ Roscoe 1.008

T158-A. Working with Newton: contexts of Newtonianism in the eighteenth century

Fri 26 July, 09:10–10:40 ▪ Roscoe 1.008

Chair: Robert Fox | University of Oxford, United Kingdom

Steffen DUCHEYNE | Vrije Universiteit Brussel, Belgium

‘Qui caste hanc methodum sequitur’: Willem Jacob ‘s Gravesande’s ‘methodological’ Newtonianism

The Dutchman Willem Jacob ‘s Gravesande (1688-1742) was, as the literature has it, one of the most influential advocates of Newtonianism on the Continent. In view of the position he took in the dispute over *vis viva*, ‘s Gravesande’s occasionally critical attitude towards Newton’s doctrines has been correctly brought to the fore. Yet, despite such mitigation of his Newtonianism, it has been maintained that he was an advocate of Newton’s methodology. In the third edition of his *magnum opus*, ‘s Gravesande himself had signalled that being a Newtonian philosopher is not contingent upon whether one accepts Newton’s doctrines *ad literam*; rather, a Newtonian philosopher is he who follows Newton’s method. Correspondingly, Gravesande’s ‘Newtonianism’ was essentially methodological, it is claimed: although he may have been selective in his endorsement of Newton’s doctrines, his adherence to Newton’s method was unremitting. In this presentation, I seek to qualify and even challenge this assessment. Based on a thorough survey of ‘s Gravesande’s *oeuvre*, I shall spell out the details concerning his appropriation of Newton’s natural philosophy and methodology in particular. I shall argue that: *i.* by restricting the scope of physics to the study of universal effects ‘s Gravesande radicalized some of Newton’s methodological precepts, *ii.* ‘s Gravesande attempted to provide a secure basis for the certainty of Newton’s natural philosophy by assimilating it into an epistemological framework that was alien to Newton, *iii.* ‘s Gravesande’s omission of Newton’s fourth *regula philosophandi* reflects profound epistemological and methodological differences between him and Newton, *iv.* ‘s Gravesande did not call attention to significant features of Newton’s methodology, *v.* ‘s Gravesande never developed a detailed picture of how mathematics and experimentation are to be integrated exactly, and *vi.* ‘s Gravesande’s views on ‘theory confirmation’ were at odds with Newton’s views on the matter. To sum up, I will document how ‘s Gravesande integrated Newtonian and non-Newtonian elements into an eclectic account of *physica*.

Satoshi NAKAZAWA | University of Tokyo, Japan

‘Innate force’ and fluid resistance in the work of Willem Jacob ‘s Gravesande

In the eighteenth century, theoretical research on fluid motion was at the forefront of mathematical physics. Especially, the problem of fluid resistance attracted wide attention because of its practical significance.

Isaac Newton first sought to explain fluid resistance in a mechanical manner. He adopted the so-called ‘impact model’, which turned out to be very useful to estimate the practical value of resistance. He obtained result that the resistance exerted on an object moving through a ‘rare medium’ is proportional to its density, as well as the square of the speed of the object. As for resistance acting on a plane obliquely placed to a uniform flow, he argued that it should be proportional to the square of the sine of the angle of incidence. He further compared the resistance induced on a cylinder moving uniformly in a medium in a direction parallel to its axis with that of a sphere with the same diameter as the cylinder moving in the same medium with the same speed, calculating that the ratio of the former to the latter should be 2:1. Newton’s followers, including the Dutch natural philosopher Willem Jacob ‘s Gravesande, adopted this theory. Later, ‘s Gravesande realised that the impact model was not a realistic assumption, and he sought to find another way out. He pointed out the difference between the impact of separate particles and the pressure of continuous fluid. According to him, fluid resistance, resulting from the pressure exerted by flow, could not be represented as the aggregate of impacts of free particles, but should rather be caused by the inertial force of moving fluid, analogous to centrifugal force. In fact, ‘s Gravesande sought to explain the phenomenon of fluid resistance by unifying Newton’s concept of inertial or innate force and the concept of *vis viva* originated by Huygens and Leibniz. He then argued that the resistance acting on a plane obliquely placed to a uniform flow was proportional to the simple sine of the angle of incidence, not to its square. As for the ratio of resistances acting on a cylinder and a sphere, he concluded that it should be 3:2, a different result from that of Newton. A quarter century later, D’Alembert discussed the discrepancy between the results of Newton and ‘s Gravesande. Although he was rather suspicious of ‘s Gravesande’s theory, he had to refer the ultimate conclusion to further experimentation.

Satoshi NOZAWA | Tokyo Institute of Technology, Japan

The confluence of two research traditions on mechanics during the first half of the eighteenth century

This study is aiming at finding a “Missing Link” in history of mechanics at the beginning of the 18th century. In a traditional view, many historians have claimed that Newton established the foundation of mechanics. But Truesdell, who was a former editor of *Leonhardi Euleri Opera Omnia*, proposed an alternative and excellent view. He argued that classical mechanics started with Euler’s formation of the equation of motion. However, from this point of view, the gap between Newton’s mechanics and Euler’s seems considerably large. This is an attempt to fill the gap by reexamining Johann Bernoulli’s mature research on mechanics.

While Johann Bernoulli is a well-known and highly appreciated mathematician, his research on mechanics have been studied little. It is partly because his mechanics has been regarded as an inconsistent aggregation of Newtonian, Leibnizian and Cartesian physics. The study is to show that there were two research traditions on mechanics (i.e. Continental and Newtonian) at the beginning of the 18th century and Johann Bernoulli contributed to merge these two traditions.

The author focused on Johann Bernoulli’s research on mechanics after his “Discours sur les loix de la communication du mouvement” (1724) and discovered that he gave two different solutions to one problem and obtained the same result: (1) the solution using the conservation of living forces and (2) the solution using Newton’s second law of motion. The former solution belongs to continental research tradition and the latter to Newtonian tradition.

In an article issued in 1735, the relation between two solutions became clearer. He treated the conservation of living forces as a heuristics and Newton’s second law of motion as a fundamental law of mechanics. As a result, compatibility of the two laws (i.e., the conservation of living forces and Newton’s second law of motion) was established. Such an understanding of these laws is quite different from the traditional view that the former was derived from the latter.

In traditional history of science, it has been believed analytical mechanics emerged as a result of applying calculus to Newton's Principia. But in reality, the formation process of analytical mechanics was quite different from the traditional view. It was formed by embedding Newton's Principia to Continental tradition of mechanics. Johann succeeded both Continental tradition and Newton's, and merged them in one.

Yoshimi TAKUWA | Tokyo Institute of Technology, Japan

Reviewing the role of the Newtonian *experimentum crucis*

Studies on optical experiments to prove Newton's new theory about light and colours, especially on the so-called *Experimentum Crucis*, have been accumulated by Richard S. Westfall, J. A. Lohne and many other researchers. Keeping a distance from the issue of 'crucial experiment' in the philosophy of science, I would like to trace the history of the role of the Newtonian *Experimentum Crucis*. To support my opinion, I cite not only Newton's original writings, but also some reports about replication of Newtonian experiments in the early eighteenth century and some Enlightenment books in the mid-eighteenth century.

Newton proposed *Experimentum Crucis*, the experiment using two prisms, in his 'New Theory about Light and Colours' in 1672. The experiment was a main source of dispute in optics primarily from 1672–1678. After that period, the dispute subsided because of Newton's silence, and since then Newton did not use the term *Experimentum Crucis* even in his book *Opticks* in 1704. Beginning in the 1730s, when Newtonian Enlightenment books, such as *Il newtonianismo per le dame ovvero dialoghi sopra la luce e i colori* by Francesco Algarotti in 1737, were distributed throughout Europe, the contents of the experiment and the term *Experimentum Crucis* drew renewed attention. Although the experiment was somewhat problematic in persuading scholars who believed the modification theory of light, Enlightenment books reasserted the experiment and made it part of the scientific myths.

T158-B. Sixteenth- and seventeenth-century natural philosophy

Fri 26 July, 11:10–12:40 • Roscoe 1.008

Chair: Anita GUERRINI | Oregon State University, United States

Yaakov ZIK | University of Haifa, Israel., Israel

What Galileo knew about optical magnification and did not disclose

The course of events between July 1609, when Galileo Galilei (1564–1642) first took interest in the telescope, and March 1610, when he published his *Sidereus nuncius*, is well known. Yet scholars are still perplexed by the question whether Galileo knew how does the telescope function? To be sure, the instrument itself is available and the practice is known, for Galileo tells the reader on different occasions what he did with the telescope. The motivating question of this paper is, then, How did Galileo turn the Dutch tubular spectacle into an astronomical telescope?

According to the received view the first spyglass was assembled without any theory of how the instrument magnifies. Galileo, who was the first to use the device as a scientific instrument, improved the power of magnification up to 30 times. How did he accomplish this feat? Galileo does not tell us what he did. Such improvement of magnification is too intricate a problem to be solved by trial and error, accidentally stumbling upon a complex procedure. I construct a plausibility argument and submit that Galileo had a theory of the telescope. He could develop it by analogical reasoning based on the phenomenon of reflection in mirrors—as it was put to use in surveying instruments—and applied to refraction in sets of lenses. Galileo could appeal to this analogy and assume Della

Porta's theory of refraction. He could thus turn the spyglass into a revolutionary scientific instrument—the telescope.

Ioannis TZORTZAKAKIS | Aristotle University of Thessaloniki, Greece

Artistic literature and the word of science: Leonardo da Vinci and Giorgio Vasari

La scietia è il capitano, e la pratica sono i soldati (*Science is the captain, and practice the soldiers*) is a phrase from Leonardo's *Notebooks* (1497) (codex I.2 82a in Richter, vol. II, 290); which could describe in short da Vinci's attitude towards what science had been for him and in his time. James S. Ackerman (1998) has noted that science in Leonardo's time had been predominantly descriptive. Further, Thereza Wells (2008) has also mentioned that Leonardo's view – of what science should be – foreshadows the critical and constructive methods of modern times; those would be knowledge through experience, reason, formation of a rule and experiment. The aim of this paper is not to take any side in the question whether Leonardo had been indeed a modern scientist or mainly a late medieval product of his time, in literary terms; but its main scope is to examine what the word "science" did mean in late medieval and early modern art and artistic literature. Giorgio Vasari, for instance, in his *Vite* (1550 and 1568) did not use the word "science" (*scienza*, *scienze*, *scienza*, *scienze*) in the life of Leonardo, while he used "science" in certain others artists, having primarily the meaning of high-developed technique accompanied by theoretical support and background. Moreover, Leonardo used 18 times three types of the word "science" – *scienza*, *scientia*, *scietia* – in his *Notebooks*. Using examples from his *Literary Works* (edition of 1883) I would like to illustrate what the meaning of word "science" had been for Leonardo and, inevitably, his era.

Jason GRIER | York University, Canada

'Not an hypothesis but most rigid consequence': the location of authority in Isaac Newton's natural philosophy

In 1672 Isaac Newton submitted to the Royal Society his "New theory about light and colours." He was attempting to solve what he regarded as the fatal flaws contained in the optical theories that existed at the time; however, he had a grander ambition. In the "New theory" he challenged the authority of the Royal Society by suggesting and developing alternative conceptions of experimental credibility, mathematical certainty and knowledge dissemination to those proposed by Robert Boyle. Newton structured the "New theory" in a manner that was a conscious response to Boyle's method. He presented his optical experiments in a failed effort to establish his authority and eliminate dissent. Insisting that experimental philosophers "not mingle conjectures with certainties," he tried to purge from his writing all conjecture and information that he deemed not to be experimentally certain or relevant. Thus, he drew a sharp distinction between hypothesis and experimental facts.

My paper will focus on Robert Hooke's response to Newton's optical theory and the dispute between them that followed in order to demonstrate a fundamental difference between Boyle and Newton's models of experimental philosophy. For Boyle it was only possible to establish that a fact was probably true. Authority was primarily a product of social status. Natural philosophy was to be done by gentlemen whose credibility—and by extension the credibility of their matters of fact—was found in their person. Newton rejected the position that a fact could only be established to be probably true; instead, he sought to present his experiments more along the lines of a mathematical proof. The event was irrelevant. What mattered was that an experiment was a repeatable incident that occurred *outside* of history. I suggest a vital difference between the methods of Boyle and Newton that is related to 'objectivity.' While Boyle located authority in the person doing and reporting the experiments, Newton placed the authority of his discoveries within the facts themselves. His were not credible because of his status, but

because they were 'objective' statements about reality. I will argue that with the "New theory" Newton began a transformation so that the power of experimental facts no longer resided in gentility or even expert status per se; instead, facts were to be regarded as 'objective' statements about the world and they were visibly shown as such through public demonstration.

Antoine GALLAY | University of Cambridge, Switzerland

Les instruments binoculaires de Chérubin d'Orléans et leur rôle dans l'élaboration de *La Vision parfaite* (1677)

Depuis le milieu de XIXe siècle, la vision binoculaire est communément reconnue comme l'une des caractéristiques physiologiques fondamentales permettant la perception du relief. Si une telle faculté apparaît aujourd'hui évidente, le rôle de la binocularité aura cependant attisé la curiosité de nombreux savants. En l'absence d'un bagage épistémologique adéquat, ces derniers sont en effet confrontés à un obstacle fondamental rehaussé encore par la conception képlérienne de l'œil: comment peut-on percevoir une image du monde unique et homogène quand chaque rétine en reçoit une image légèrement – mais, d'un point de vue géométrique, *essentiellement* – différente? L'hypothèse la plus radicale, la plus commode et la plus largement adoptée suggère que la vision se fait constamment au travers d'un seul œil; la binocularité n'a pour autre fonction que d'élargir le champ de vision et de conserver la faculté de perception si l'un des deux yeux vient à être affecté d'un quelconque handicap ou maladie.

Si comme l'affirme Jonathan Cray, la binocularité n'aurait peut-être occupé qu'une place marginale au sein des théories de la vision avant le XIXe siècle, on peut néanmoins reconnaître plusieurs éléments révélant la présence d'une certaine controverse dans les décennies qui suivent la publication de la *Dioptrique* de Descartes (1637). Tandis qu'à Paris, Pierre Gassendi et surtout Sébastien Le Clerc se font les apôtres de la monocularité, un frère capucin et fabricant de télescopes, Chérubin d'Orléans, développe une importante théorie de la perception binoculaire, *La Vision parfaite* (1677, 1681), dans lequel il attaque systématiquement toute position « monoculariste ».

Cette présentation vise à comprendre par quelle méthode et pour quelles raisons une véritable théorie de la vision binoculaire peut être produite à la fin du XVIIe siècle, plus de 150 ans avant la découverte du rôle de la binocularité dans la perception du relief. Loin d'être une « préfiguration » des théories physiologiques du XIXe siècle, *La Vision parfaite* répond à des intentions précises qui sont, ainsi que je le démontrerai, fortement liées au succès que rencontrent les instruments binoculaires de Chérubin auprès de la noblesse française, et plus largement, à un véritable programme d'*autopromotion* au sein de la cour de Louis XIV.

T158-C. Prints, texts and readings

Fri 26 July, 14:10–15:40 ▪ Roscoe 1.008

Chair: Jason GRIER | York University, Canada

AWANO Hiroshi | Yamagata University, Japan

The ups and downs of the early arts of typographic printing in the East and the West: considered from the viewpoint of the ripeness of reproduction technology

Gutenberg's system of technique did spread all over the western world, as soon as it was established in the first half of 15th Century. Compared with the arts of typographic printing in West Europe, they were established much earlier in East Asia, but they did not spread all over East Asia. The situation that was ever seen in the East is in sharp contrast to the situation in the West. It has been repeatedly said that, in order to explain the contrast, the predominant factor is the difference of writing systems, simple alphabetical one being used in the West and

complicated Chinese characters as ideograms and hieroglyphs. Nevertheless, we discuss here additional significant factors which are inherent within the technological context. Both the clay (ceramic) movable-types, invented in China four centuries before the Gutenberg revolution, and the wooden movable-types, succeeded to be utilized in China in the early 14th century, were fabricated without molds one by one. The metal movable-types, first initiated in Korea in 13th century, were cast with prototypes and matrices, but the prototypes made of beeswax or paraffin wax completely melted down and the matrices made of clay or sand were destroyed on each occasion. On the contrary, both the prototypes (punches) and matrices in the Gutenberg's technical system could be used repeatedly and almost permanently. Thus, the Gutenberg's technical system has gained a higher ripeness of reproduction technology. Such difference has determined the ups and downs of early arts of typographic printing in the East and the West.

Gwyndaf GARBUTT | University of Toronto, Canada

Mapping a marvelous world: standards of evidence in the 'Defective Version' of *The Book of John Mandeville*

This paper examines the Defective Version of The Book of John Mandeville as a case study of the construction of natural knowledge in late 14th century Britain. I examine the Mandeville author's discussions of flora and fauna, particularly marvelous creatures, to explore the standards of evidence in medieval discussions of nature. As one of the most widely read works of its age The Book offers us an interesting opportunity to explore the presentation of natural information to a non-scholastic, vernacular, reading public. The Book of John Mandeville is a travel narrative purporting to be written by the English knight John Mandeville recording his experiences on pilgrimage to Jerusalem and his journeys into the Far East. The world he travels through is one full of fabulous creatures and strange races, from men with their faces in their chest to lambs born from fruit. Through this account of his marvelous journey the author constructs a complex, and to many of his readers convincing, vision of the world using knowledge claims drawn from the scholarly authority of encyclopedias, histories and religious works combined with the eyewitness accounts of travelers. The world he describes has both natural and spiritual significance; something scholars sometimes refer to as natural and spiritual geographies. In this paper I argue that these two geographies—distinct but intertwined understandings of the world—provide differing contexts, and through them differing standards, for creating knowledge claims. The Mandeville author's approach shifts fluidly between contexts, moving from one kind of evidence to another or employing multiple types of evidence to establish a point that functions within multiple contexts. The Book allows us to examine how claims based on authority, eyewitness and common knowledge interact; shifting their epistemic value in relation to the subject's position in these intertwined spiritual and natural geographies. By exploring these themes in the Defective Version of The Book of John Mandeville I will begin to unpack some of the practices of evidence use associated with the presentation of natural information to a late 14th century audience.

Irene GOUDAROULI | University of Athens, Greece

"Scientific" concepts in the making; Thomas Hobbes and the 17th century distinction of proper and non proper knowledge

What role does language play both in knowledge making and its transmission in different contexts? How can the study of concepts contribute to the study of knowledge shaping? In this paper the study is focused on the particular ways language, or more precisely concepts are used by actors; a historical fact that plays fundamental role both in the distinction of "scientific" from non "scientific" knowledge and in the definition of the natural objects themselves, while at the same time it is a crucial factor that mediates, categorizes and shapes the relation between the natural and the historical world. *Leviathan* the revolutionary

work of Thomas Hobbes and its historical background will be the main focus of this paper. Through the study of the connections the concept *incorporeality* and its various articulations develop with the sociopolitical tensions reflected in the text, I will try to identify the ways in which a certain kind of scientific knowledge was shaped while it kept distinct from other ways of doing natural philosophy during the mid-17th century. The shape and the categorization of knowledge are primarily performed within language, and that's the central concern of this paper.

Marígia Mádje TERTULIANO DOS SANTOS | Pontifical Catholic University of São Paulo - PUC/SP, Brazil

José Luiz GOLDFARB | Pontifícia Universidade Católica de São Paulo, Brazil

Sobrecarga de informações e conhecimento: uma análise historiográfica comparativa entre o processo que levou a formatação do livro, nos séculos XVI a XVIII, e a realidade do século XX

Há muito a sobrecarga de informações faz parte dos estudos que analisam a construção do conhecimento, nas diferentes esferas. Isso já se refletia na condição acadêmica no período compreendido pelos séculos XVI a XVIII - no início da modernidade. Este fato já era percebido pelos homens de ciência da época, os quais a partir de percepções individuais definiam as formas de selecionar o que seria lido ou produzido - sejam destinados a sanar o problema de novos gêneros - como a bibliografia universal e a resenha do livro para jovens que se iniciaram no mundo da "nova ciência", o dicionário e a compilação enciclopédica[1]. Em sua maioria, no século XVII, os instrumentos de seleção variavam conforme a época, e esses podem ser vistos como uma iniciação ao processo de censura, quando aos novos leitores eram recomendadas às leituras direcionadas por seus professores, uma vez que estavam sendo formados. A superabundância fomentou a difusão e desenvolvimento de novas ajudas para a aprendizagem, bem como afetou a forma como trabalhavam os estudiosos - a partir da leitura e das tomadas de notas dos livros que criavam. Esses fatos indicam que na maioria dos períodos, apesar da seletividade das obras, "os leitores proficientes implantaram uma série de diferentes tipos de leituras em diferentes circunstâncias" [2]. No século XX o problema continua com outras conotações. As leituras seletivas e anotações continuam a ser realizadas com a ajuda da máquina; o volume de livros aumentou exponencialmente, assim como os recursos para sua produção, bem como o tamanho e tipos de bibliotecas, entre outros. O que se percebe é que apesar da garantia do acesso, como nos séculos XVI ao XVIII, não se tem a certeza da leitura e da legitimação do conhecimento. Assim, questiona-se: como reconhecer aquilo que é passível de ser conhecimento e como o legitimar? Logo, a proposta deste artigo é realizar um pré-levantamento de alguns métodos de gestão da informação - seleção, classificação e armazenamento de dados, utilizados em diversas combinações de motivos e tecnologias, no século XX, que consistem em novos meios de transmissão, acesso e produção do conhecimento.

[1]A. BLAIR. Reading Strategies for coping with information overload, CA. 1550-1700

[2] Id. Ibidem

Overload of information and knowledge: a comparative analysis of the historiographical process of writing books from the sixteenth to the eighteenth century and the reality of the twentieth century

There is so much information in the studies that analyze the construction of knowledge in different subjects. This has been reflected in the academic condition in the period from sixteenth to eighteenth centuries, the early modernity. This fact was noticed by the time. The individual perceptions defined the ways of selecting what would be read or

produced. How they intended to lead with the problem of the production of literatures, such as universal bibliography or the book review for young people who were in the world of "new science", dictionary and encyclopedic compilation. In the seventeenth century, the instruments of selection varied according to season and these can be seen as an introduction to the process of censorship, when the new readers were directed to the readings recommended by their teachers, as they were being formed. The overabundance encouraged the dissemination and development of new aids for learning have affected how the scholars had led from the reading and understanding from books that they had created. These facts indicate that in most periods, despite the selectivity of the works, "proficient readers deployed a number of different types of readings in different circumstances." In the twentieth century the problem continues with other connotations. The selective readings and annotations continue to be performed with the help of the machine and the volume of books increased exponentially, as well as resources for their production as well as the size and types of libraries, among others. What we see is that despite the guarantee of access, as in the sixteenth to the eighteenth centuries, not sure of reading and legitimation of knowledge. So, the question is: how to recognize what is likely to be the legitimate knowledge and how? Therefore, the purpose of this article is to conduct a pre-survey of some methods of information management - selection, classification and data storage, used in various combinations of motives and technologies in the twentieth century, consisting of new means of transmission, access and knowledge production. Keywords: history of science, historiography, information, knowledge, twentieth century.

T159. Place and affect in early-modern sciences

Mon 22 July, 11:00–17:30 ▪ Uni Place 4.204

T159-A. Early modern

Mon 22 July, 11:00–12:30 ▪ Uni Place 4.204

Chair: Adam MOSLEY | Swansea University, United Kingdom

Nadia AMBROSETTI | Università di Milano, Italy

The automaton meme: an evolutionary study of protocybernetics from antiquity to the Renaissance

People and scholars have been fascinated by automata starting from Antiquity: automata have often been related to the idea of creation, suggesting that man could build another artificial being, by means of his competence and knowledge, forcing or imitating natural laws. This study covers automata history ranging from the Antiquity to the Renaissance, due to the strong interdependence of design and content, recurring during the considered centuries. It also aims to outline, in the framework of memetics, the evolution of the mechanical devices called automata from the ancient world to the 16th century CE, on the basis of a collection and historical analysis of literary and technical sources on the subject, both in Eastern and Western traditions. The first step was to collect sources (now searchable in our online data base at <http://www.cyberprof.it/automata>); in this way we could represent automata appearance and behavior thanks to UML diagrams and we identified features and characteristics of the automata included in our

sources data base. The use of UML enabled an easier classification of the individual automata, considered as instances of more general classes (manlike, animal, musical instrument,...); and of their specific behavior traits (allomemes), represented as methods of the class or of the instance. In a binary table we represented the presence/absence of specific traits for each automata instance. From the binary table we built the distance matrix among the automata with the Minkowski algorithm ($P=0$). As a last step, thanks to a technique already used in the context of memetic studies in the field of archeology by Sartika (Tracing Cultural Evolution Through Memetics. WPF2004, Bandung Fe Institute) and by Bloom (The Lucifer Principle: A Scientific Expedition into the Forces of History. 1995, New York), an automaton phylomemetic tree has been drawn with the UPGMA (Unweighted Pair Group Method with Arithmetic Mean) method, assuming mutation rate as constant. Some relevant considerations arose from the tree analysis; first of all, independence from historical background: in any tree branch we consider, we can find associated automata belonging to different periods, as branches are neither chronologically nor culturally ordered. Secondly, the idea of automaton appears to evolve more rapidly than the technical implementation possibilities, at least in the considered period.

Laura MITCHELL | University of Saskatchewan, Canada

Thomas Fayreford and the transmission of secrets and recipes in Harley MS 2558

This paper will examine the transmission of secrets and related literature in London, British Library Harley MS 2558, the fifteenth-century medical notebook of Thomas Fayreford. Fayreford's book contains, among a wide assortment of medical and surgical texts, numerous medical recipes that he collected from fellow physicians as well as from his clientele and other people he met in the course of his work as a medical practitioner. His book will serve as a case study to examine the informal communities of compilation that made up a vital area of late medieval book production. In particular, this paper will focus on a handful of recipes that Fayreford explicitly states were obtained from others or which he shared: two medical recipes for demigreyne that he received from Lady Poynyngs (one of his patients), and a friar John, respectively; and a recipe to extract a tooth using a frog that Fayreford describes as one of his "privytes", or secrets, which he claims to have sold. The history of science in recent decades has begun to examine the social construction of science and the nature of the scientific community. Deborah Harkness, for example, focused her book, "The Jewel House", on the informal networks of exchange surrounding the study of nature in Elizabethan London. Further, there is a growing body of literature on the exchange and use of recipes and household receipt books in the seventeenth and eighteenth centuries. The work of these scholars has demonstrated that there existed explicit communities of interest and exchange in the early modern period. These sorts of communities, however, have a long and un-studied pre-history. The kind of community in which Fayreford was compiling his book is analogous and in some ways a precursor to the intellectual communities and networks of the early modern period. My paper therefore intends to bring some of this medieval pre-history to light by examining the community in which Fayreford participated and the secrets and recipes he shared and acquired within his particular community.

Saskia KLERK | Universiteit Utrecht, Netherlands

Taste, therapeutic experience and late Galenic pharmacology at Leiden University, 1575-1625

As Andreas-Holger Maehle (1999) pointed out, discrepancies between the taste of drugs, such as Peruvian bark and opium, and their effects, were used to criticize Galenic medicine in the first half of the 17th century. In this paper I will argue that, ironically, it was the study of medicinal drug properties within the tradition of Galenic medicine itself which brought to light the discrepancy inherent in Galenic drug theory between medical theory and practice, and between knowledge derived from reason and from experience. According to this theory, drug

properties were supposed to be investigated and established through both taste and therapeutic experience. The relationship between these two ways of getting to know a drug, that is through reason and through experience, was examined in a number of texts written by authors connected to the University of Leiden. I will show that these texts by Rembert Dodonaeus (1517–1585), Johannes Heurnius (1543 -1601), Adrianus Spigelius (1578–1625) and Gilbert Jacchaeus (ca.1585-1628) were part of an effort to incorporate drug properties known through therapeutic experience into an elaborate system of different primary, secondary, tertiary and quaternary qualities or faculties. In his innovative textbook *Institutiones medicinae* or "The foundations of medicine" (1592) Heurnius made Galenic drug theory the cornerstone of his efforts to develop a *methodus medendi*. By the study of this rational method of treating patients, already discussed by Galen, and by developing it further, Renaissance physicians hoped to overcome the division between medical theory and practice that existed in medieval universities and thus to restore the connection between the two as envisioned by Galen. Figuring out how drug properties could be related to each other and how they worked to cure diseases became a core problem for maintaining a medical practice that was both rational and effective. However, it was precisely in trying to understand the various properties of drugs, including their taste, within the Galenic framework, that the properties of some drugs became problematic. This encourages us to consider the idea that the changes with regard to the notion of qualities and the constitution of matter occurring at this time, arose, at least partially, from discussions within Galenic medicine itself.

Aya NAKAMA | Kyoto University, Japan

Visualizing optical theory and theological argument: image, materiality and the emotional effect of German gothic sculpture in the thirteenth century

Masters of gothic stonemasons had great knowledge of theology, natural sciences like also the crossover of philosophy, physics, geometry, anatomy and ophthalmology, which was central to visual experience providing a historical framework within the relationship between perception and imagination. The materiality of light was emphasized, in particular with concepts of species transmitted by ray blending models of Platonic extromission and Aristotelian intromission, which appealed to the spectator's visual and tactile senses in the narratives of image.

This presentation focuses on sculpture as major medium in the 13th-century Germany, in particular, works created by workshops of Cathedrals in Bamberg, Meissen and Naumburg, which I argue to be created in the novel way of combining optical theories with art, one of whose benefactors was the Holy Roman Emperor Frederick II. Preceding Robert Grosseteste and Roger Bacon, Frederick's court was the contemporary center of discovery and translation of Greek and Arabic optical treatises, like those of Alhacen and Averroes. Frederick's great interest on harmonizing art with science is also evident in his courtly literature with detailed reference of optical discourses.

Mastermasons could combine art with science directly in practice by reflecting them on their own imagination. As both architects and sculptors, they tried to create total entity of sacred space and as their works were of central religious practices, their images had to be appealing vehicle of contemplation. The emotional effects of startling eye, orienting eyesight of direct eye contact were reinforced by epistemological optical process, which was also legitimated by theologians.

At issue are the ways in which artists responded to contemporary optical theories in creating sacred images within theological arguments, like in the interpretation of intact penetration of light on the surface of transparent objects, which thought to exemplify contemporary theological arguments about immaculate conception of the Virgin Mary. The possibilities of illustration of scientific optical diagrams directly projected on statues to represent the Virgin's miracle will also be pointed out.

This presentation aims to shed light on the place of scientific knowledge in artist's practice in the Middle Ages by demonstrating one property of gothic sculpted works with dynamic combination of optical theories by mastermason imitating god as scientist as pictured in the Bible moralisée.

T159-B. Spaces and practical knowledge

Mon 22 July, 14:00–15:30 ▪ Uni Place 4.204

Chair: Laura MITCHELL | University of Saskatchewan, Canada

Clare HICKMAN | Kings College London, United Kingdom

The garden as a laboratory: the role of domestic gardens as places of scientific exploration in the long eighteenth century

Eighteenth-century gardens have traditionally been viewed as spaces designed for leisure, and as representations of political status, power and taste. In contrast this paper will explore the concept that gardens in this period could be seen as dynamic spaces where scientific experiment and medical practice could occur. Two examples have been explored in the pilot study which has led to this paper - the designed landscapes associated with John Hunter's Earl Court residence, London, and the garden at Edward Jenner's house at Berkeley, Gloucestershire. Garden history methodologies have been implemented in order to consider the extent to which these domestic gardens can be viewed as experimental spaces.

The use of garden history methodology with its focus on the close reading of individual sites through site walking (where possible), maps and primary archival research, can complement and add new dimensions to our understanding of the role and use of domestic gardens. Garden history, with its interest in space, place and material cultures, speaks to recent trends in other historical fields, and of course geography and archaeology. It also forms part of a wider movement which seeks to further our historical understanding through an analysis centered on material culture – in this case, physical landscape features. This approach corresponds to the growing interest in the development and practice of science beyond that of the nineteenth-century construct of the laboratory. However, unlike recent work in this area by Kohler, Naylor and others, this article will focus on designed spaces rather than the field and, therefore, also seek to re-define the garden as a 'liminal' space which exists between the wilder 'field' and, the more managed and ideally placeless, 'laboratory'. This approach will build on the research being conducted, predominantly by historical geographers, on the relationship between space, place and science.

Adam MOSLEY | Swansea University, United Kingdom

'A death greatly exaggerated': the life of Renaissance cosmography after 1600

Historians who have studied Renaissance cosmography - a discipline or practice or genre that combined elements of both astronomy and geography, and sometimes encompassed history, natural history, astrology, ethnography, and other subjects as well - have been prone to declare that it quickly disappeared. Some scholars have placed its demise as early as the end of the sixteenth century. It is my contention that such claims are erroneous, and have arisen in part because of a failure to appreciate that cosmography took a range of interrelated forms, both in the Renaissance and subsequently. I shall present evidence that 'cosmography', though apparently superseded by the distinct disciplines of astronomy and geography, enjoyed an extensive post-Renaissance life, and persisted as a scientific category in certain contexts even into the twentieth century. As well as telling us about the evolution of knowledge-making practices between and within disciplines, from 1500 onwards, study of this phenomenon raises a historiographical

question. If, as I argue, 'cosmography' was still alive as an actor's category into the modern era, then can it safely be employed as a term of the historian's art for that period, as others have advocated? I shall suggest that the hazards of doing so outweigh any benefits. If we are to understand cosmography, in all its variety, we need to establish what the term meant to various individuals in diverse contexts; describing as 'cosmographic' ideas and practices that were not considered as such by those who originated them only makes that task harder. Indeed, such 'contamination' of the historical record has contributed to cosmography being so poorly understood until very recently.

Matti YLIPIESSA | University of Oulu, Finland

Seamen's and scientists' tides: how practical knowledge of the tides was used in sixteenth-century natural philosophy. A case study on Nicolo Sagri and Francesco Patrizi of Cherso.

Seamen's and scientists' tides. How the practical knowledge of tides was used in the 16th century natural philosophy. Case study on Nicolo Sagri and Francesco Patrizi of Cherso.

The debate on the causes of the tides was very lively in the late 16th century within learned circles. But although the interest in tidal theories was high, the tidal data that was then available and quite accurate, was seldom used in theoretical contexts. A notable exception in this was Italian renaissance philosopher Francesco Patrizi, who systematically and with a good profit used the tidal data presented by Nicolo Sagri, Venetian master mariner.

The use of the Sagri's data made it possible for Patrizi to forcefully argue against then popular lunar theories of tides. Patrizi's arguments against lunar theories contained also some new ideas which stemmed from the tidal observations collected by Sagri.

Patrizi's use of Sagri's data in his "*Nova de universis philosophia*" (1591) proves that he saw this Italian mariner as a credible source of empirical information – this was against natural philosophy's tradition, which preferred classical writers for empirical data or examples. The reason why Patrizi trusted in Sagri requires then an explanation. My argument is that Sagri's way to provide the tidal data – it was systematic, comprehensive and specific – is the key here. Another reason might be that Patrizi in his youth became to know Venetian mariners' practices and probably also the portolan books, or coastal sailing guides, which were Sagri's primary source of information when he wrote his "*Ragionamenti sulla varietà dei flussi del mare Oceano Occidentale*" (1574). It is noteworthy that Patrizi does not even mention Sagri's tidal theory. In this Patrizi can be seen as an orthodox natural philosopher; to him it was still and only the scientist who had an access or a capability to the causes of the natural phenomena.

Anita GUERRINI | Oregon State University, United States

Une affreuse cuisine

The ghastly kitchen

The metaphor of "the ghastly kitchen" of life science research, the places that, said the physiologist Claude Bernard, stirred "the fetid and throbbing ground of life," is well known. This paper concerns not a metaphor, but an actual space. In the early modern era and particularly in the seventeenth century, the kitchen, or a room in a private home that stood in for a kitchen, was quite often the site where life science was done. I will argue that the kitchen corresponds to what Michel Foucault in *The Order of Things* referred to as a heterotopia, or what Peter Galison, and more recently Pamela Long, have called a "trading zone." Looking in particular at the uses of animals in experimental natural philosophy in this period, I will look at ways in which the kitchen served as a laboratory, and ways that the laboratory served as a kitchen. I will say something about the places in which experimenting occurred;

the actions, including cooking, eating, tasting, and smelling, that occurred in these places; and the animals that experimenters sacrificed.

T160. Topics in nineteenth-century physics

Thu 25 July, 09:10–12:40 • Uni Place 4.214

T160-A. Eighteenth- and nineteenth-century physical sciences

Thu 25 July, 09:10–10:40 • Uni Place 4.214

Chair: Katy PRICE | Queen Mary, University of London, United Kingdom

Eri YAGI | Eri Yagi Institute for History of Science (NPO G.K.N.), Japan

Clausius on Nagaoka's development of his atomic model

Through my research on Clausius these past 30 years, I could achieve a better understanding of the relation between Rudolf Clausius and Hantaro Nagaoka. In one of my previous papers on Nagaoka's Saturnian atomic model in 1972, I referred to Clausius's Virial, applied for the molecules from the Saturnian atomic models in 1905. I studied Nagaoka's atomic model and its development and published a number of papers between 1965-74, together with his biography. Then I have published a number of articles and a book on the mechanical theory of heat in the 19th century. At the coming Congress, I will discuss the background of the above relation together with Nagaoka's approach.

Rika OKAMOTO, NEE TADOKORO | The Graduate University for Advanced Studies, Japan

A study of statistical approaches to Rudolf Clausius's theory of electricity

One of recent topics in informatics is "Information Retrieval for historical documents." The topics for history of science, also for scientists, searching for old scientific documents is a key demand in the world of digital documents. This study reveals how different among Clausius's four papers classified under the same title of the theory of electricity, using statistical methods. We, Dr. Eri YAGI (Prof. Emeritus of Toyo University in Japan) and I have studied on R. Clausius (1822-1888) through both quantitative and qualitative approaches over twenty years. In the way of these approaches, we can obtain better understandings how different Clausius's theory of electricity and his "mechanical theory of heat" are. I will mainly discuss on the difference between Clausius's XIIIth paper (1853) and his other three papers by some statistical analyses on self-made digital documents for Clausius's theory of electricity, which were originally written in nineteenth century.

Kenichi NATSUME | Kanazawa Institute of Technology, Japan

An atomistic interpretation of the concept of 'mass' given by Faraday

Michael Faraday presented his law of electrolysis in 1833. This law was divided into two parts, each of which was precisely redefined in 1834. The first part states that "the chemical power of a current of electricity is in direct proportion to the absolute quantity of electricity which passes," and the second part states that "electro-chemical equivalents coincide, and are the same, with ordinary chemical equivalents." The second part

integrated electrical power with chemical power, and opened up a new way for the unified theory of natural forces.

However, this radical view was met with opposition, especially from Swedish chemist J. Jacob Berzelius. Advocating Dalton's atomic theory, Berzelius considered Faraday's law to be insufficient and inadequate, because Faraday had ignored the influence of chemical composition. Although electrochemical decomposition needed a certain level of intensity at the beginning, and generally speaking, chemical affinity was related to electrical intensity, Faraday's law was not related to intensity. Only weight was correlated with the quantity of electricity, and both weight and chemical action were reduced to just electrical power.

This opposition was based on their different perspectives of weight, or more precisely, "mass" of matter. I analyze this Faraday's view as derived from Humphry Davy's. Davy said that, "chemical and electrical attraction were produced by the same cause, acting in one case on particles, in the other on masses." Furthermore, he stated that electrochemical voltaic action was a combination of chemical and electrical actions. Faraday probably applied this idea in order to develop his research on the electrostatics of "mass" toward the new theory of electro-ionic dynamical phenomena of the "particle."

From the perspective of Dalton's atomic theory, mass is basically equivalent to the weight of matter. In contrast, by understanding matter as a force, as in Boscovich's dynamical atomism, mass becomes the aggregate of the total action of the atomic powers. From this second perspective, Faraday must have reduced several aspects of the natural powers in the case of electrolysis. I will discuss this unique idea of mass derived from dynamical atomism in the nineteenth century.

Masanori KAJI | Tokyo Institute of Technology, Japan

The classification of elements and responses to the periodic law in Japan up to the 1920s

This paper will analyze the history of the classification of elements in Japan including responses to the periodic law between the 1830s, thirty years before the Meiji Restoration in 1868 (the starting year of full-fledged modernization) and the 1920s, before the advent of quantum chemistry, a development that enabled Japanese science to become mature enough to organize large-scale international conferences. Before the Meiji Restoration, some scholars in Japan began studying western science, technology, and medicine by reading Dutch, since the Netherlands was the only European country with which Japan traded. One such scholar, Udagawa Yoan, wrote the first introductory textbook of chemistry, published between 1837 and 1847 and also introduced Lavoisier's new chemistry into Japan. After Udagawa, Kawamoto Komin introduced Dalton's chemical atomism into Japan during the 1860s. During that early period, some European chemistry textbooks were translated into Japanese; Japanese intellectuals who were interested in chemistry also read Chinese translations of European texts on chemistry. Soon after the Meiji Restoration, foreign teachers of chemistry were employed by the Meiji government to promote the westernization of Japan, and the publication of their translated lectures played an important role in the first stage of the institutionalization of chemistry. During this period, various editions of very popular introductory chemistry textbooks, such as those written by Roscoe and Ramsen, were translated into Japanese. The first stage of the institutionalization of chemistry in Japan was completed with the establishment of the Tokyo Chemical Society in 1878 and the foundation of the first Imperial University in Tokyo in 1886. The discovery of the periodic law in 1869-71 and its dissemination in the 1880s coincided with this institutionalization. This factor helped ensure a smooth reception of the periodic system as a basis for chemistry in Japan. Most of the first generation of Japanese chemistry professors accepted the periodic law as one of the most important developments in chemistry in Europe; they also wrote the first chemistry textbooks for middle schools and universities, based on the then current English and German chemistry textbooks. Ikeda Kikunae, one of few exceptions in the first generation chemists, argued the

limitations of the periodic law. His thinking was influenced by Friedrich Wilhelm Ostwald, who was Kikunae's mentor while studying in Europe.

Michael BYCROFT | University of Cambridge, United Kingdom

What has natural history done for physics? The case of electricity in eighteenth-century France

Little is known about the contribution of natural history to the emergence of experimental physics after c.1700. A good place to look for connections between the two disciplines is France in the first three-quarters of the eighteenth century, when Frenchmen played key roles in the definition and dissemination of both natural history and experimental physics. This talk surveys the role of natural history—understood as the collection, description and classification of plants, animals and minerals—in the growth of the most visible branch of experimental physics at the time, electricity. One role for natural history in this domain was to throw up curious phenomena (such as the electric fish) that were then subjected to the rigour of experimental analysis. But natural history was also a *source* of experimental rigour. This is clearest in the work of Charles Dufay, whose systematic style of experimentation owed much to his immersion in the culture of curiosity of early eighteenth-century Paris. Dufay used a wide range of carefully chosen minerals to show the generality of the electric virtue, examine its laws, and amplify its effects. Four of Dufay's notable successors—Jean-Antoine Nollet, Jacques-Mathurin Brisson, Louis-Guillaume le Monnier, and Etienne-Francois Dutour—carried out research in natural history before turning to electricity, and their experimental physics bears the stamp of their naturalist training. This survey draws attention to a person (René Réaumur), an institution (the Jardin des Plantes), and a discipline (mineralogy) that deserve greater prominence in histories of French experimental physics.

Qu'a fait l'histoire naturelle pour la physique? Le cas de l'électricité en France au dix-huitième siècle

On ne sait pas grand-chose sur la contribution de l'histoire naturelle au développement de la physique expérimentale après 1700. On peut commencer par chercher des connexions entre les deux disciplines en France lors des premiers trois-quarts du dix-huitième siècle. Pendant cette période des Français comme Georges Buffon et Jean-Antoine Nollet jouèrent un rôle important dans la définition et la dissémination de l'histoire naturelle et de la physique expérimentale. J'examine ici le rôle de l'histoire naturelle—en termes de collecte, de description et de classification des plantes, des animaux et des minéraux—dans le développement de la partie la plus visible de la physique expérimentale, à savoir l'électricité. Ce rôle est clair dans le cas de Charles Dufay, dont les recherches méthodiques sont dûes en grande partie à son intérêt pour la collecte de minéraux, goût qu'il partagea avec ses collègues Argenville et Buffon. Dufay utilisa un large éventail de minéraux soigneusement choisis pour montrer l'universalité de la vertu électrique, pour étudier ses lois, et pour amplifier ses effets. Quatre des successeurs les plus importants de Dufay—Nollet, Jacques-Mathurin Brisson, Louis-Guillaume le Monnier, et Etienne-Francois Dutour de Salvert—étudièrent l'histoire naturelle avant de se pencher sur l'électricité, et leurs recherches physiques portent la marque de leur formation. Cette esquisse attire l'attention sur un savant (René Réaumur), une institution (le Jardin des Plantes à Paris), et une discipline (la minéralogie) qui mérite qu'une plus grande place lui soit accordée dans l'historiographie de la physique expérimentale en France.

T160-B. Discipline and metrology

Thu 25 July, 11:10–12:40 • Uni Place 4.214

Chair: Jay MALONE | History of Science Society, United States

Tapio MARKKANEN | University of Helsinki, Finland

The origins of the classical observatory: turning the temple of science into a functional shelter for the telescope.

At the end of the 18th century and at the beginning of the 19th century the observatory buildings changed because the astronomical tools of observation changed from light portable equipment into permanently mounted accurate instruments. For positional astronomy, the observations were mainly carried out in the meridian or in the prime vertical. For observation of objects like planets, comets and double stars, a new type of telescope, the equatorially mounted refractor became important. The new instruments and methods of observation also required new approaches to observatory design. The outside appearance of the house, its whole structure from the foundations to the roof, and the functions of the observatory were determined by the new needs of science. At the beginning of the 19th century, new standards of observatory planning were developed when the new observatories of Tartu, Helsinki and Pulkovo were built. During many decades the principles adopted for their design guided the construction and architecture of avant-garde observatories round the world. They also provided for the archetype of the observatory as a universal emblem for science well into the 20th century. The steps of development of the design principles and their global impacts are discussed.

Yuto ISHIBASHI | Japan Society for the Promotion of Science, United Kingdom

Maintaining the 'accuracy' of standard time: George Biddell Airy's contribution to time distribution at the Royal Observatory, 1850-1880

This paper investigates the ways in which George Biddell Airy, Astronomer Royal, strove to maintain the highest degree of accuracy of standard time disseminated from the Royal Observatory Greenwich to the wider public between the 1850s and 1880s. Recent studies on the standardisation of time in the Victorian age have indicated that early electrical time signalling was not as accurate or reliable as historians have commonly assumed. They have highlighted a considerable number of technical failures and inaccuracies which occurred in the distribution of time signals. However, in spite of these shortcomings, the Greenwich time service earned public trust, which led to its continuous use as the standard of time by railway companies, seafarers, and clock and watch makers who demanded accuracy in timekeeping.

In this paper, I will argue that this adoption of the newly-established way of public timekeeping was due primarily to Airy's formulation of three different strategies aimed at developing the overall effectiveness of the service. Firstly, this paper considers technical aspects of time distribution, with particular emphasis on how Airy guaranteed the functionality of time signalling by conducting a series of experiments and creating a technique to measure the accuracy of the time he disseminated. Secondly, the paper focuses on the importance of Airy's public image as a scientific authority; a key factor in further enhancing the credibility of the Greenwich time service. Thirdly, this paper suggests that Airy's consistently coherent response to those who cast doubt on the accuracy of the time signal was instrumental in preserving the trustworthiness of his timekeeping venture.

Frédéric SOULU | Independent scholar, France

The diffusion of the electro-chronograph in French astronomical practices

Introduced in Europe in the mid nineteenth century, coming from the United States of America, where it appeared in the context of determining longitude by telegraph, the printing electro-chronograph, has, however, not been adopted in France before the beginning of the

twentieth century .

Yet it is admitted, since the article by Simon Schaffer, "Astronomers mark time" (1988), that the use of electric chronograph at Greenwich Observatory from 1854 is a result of changes in practices within the astronomy : the advent of the "factory observatory."

In France, at least two prototypes were manufactured in the mid-nineteenth century. One was designed by Ignazio Porro (1801-1875) as part of his "parc astronomique". Emmanuel Liais (1826-1900), developed his own printing chronograph between France and Brazil. Despite the "reorganization" of parisian astronomy by Urbain Le Verrier (1811-1877), it was not until 1900 that Maurice Loewy (1833-1907), then director of the Paris Observatory, promotes the model of Porro. He had discovered a copy modified by Aloys Verschaffel (1850-1933) in operation at Abbazia observatory. Paul Gauthier (1842-1909), gave a version of it which equipped all French national observatories in the early twentieth century.

It seems that the main obstacle to the use of this instrument is due to the situation of the French institutional astronomy in the second half of the nineteenth more than a technical problem.

T161. Modern physics and astronomy at work

Fri 26 July, 09:00–15:30 ▪ Schuster Blackett

T161-A. Twentieth-century astronomy

Fri 26 July, 09:00–10:30 ▪ Schuster Blackett

Chair: David DEVORKIN | Smithsonian Institution, United States

David BANEKE | VU University, Amsterdam, Netherlands

Dutch astronomy after Oort: reorganizing a scientific community in the 1970s

1970 was a year of triumph and of crisis in Dutch astronomy. Triumph, because the largest radio telescope in the world was inaugurated in Westerbork, Adriaan Blaauw was appointed Director General of the European Southern Observatory (ESO), and Stuart Pottasch from Groningen became editor of the new European journal *Astronomy and Astrophysics* (A&A). But behind the scenes there was also a sense of crisis. Jan Oort, the grand old man of Dutch astronomy, was about to retire. The resulting leadership crisis coincided with dramatic changes in national science policy, funding, and management that also affected astronomy.

The institutional structures of science that had been built up after the Second World War had functioned well for two decades, but the cultural, political and economic developments of the late 1960s and early 1970s put them under increasing pressure. This resulted in a lot of soul-searching by the new generation of astronomers, as they discussed both the future direction of astronomical research in the Netherlands and the way in which it should be organized. The informal way in which the generation of Oort had run scientific institutions had to be replaced by more formalized bureaucracy and accountability. For example, the management of the Westerbork radio telescope was radically reorganized, and A&A introduced a refereeing system.

In this paper I will analyze the sometimes painful change of the Dutch astronomical community in the early 1970s: how the new generation adapted to the challenges of the new decade, and how they dealt with potential conflicts that could split the thriving but fragile discipline. In this way, this paper will improve our understanding of the 1970s, a crucial period in the history of postwar science.

Shanshan CHU | Chinese Academy of Sciences, China

The 1958 Sino-Russian joint observation of the annular solar eclipse in Hainan Island and the beginning of radio astronomy in China

This dissertation studies how radio astronomy began in new China under its special scientific, social and political backgrounds. As a new field of astronomy, radio astronomy was developed in new China at the end of the 1950s. Its birth is closely related to the needs and planning of scientific development of the country in its early days, but is also the result of the 1958 Sino-Russian joint observation on the annular solar eclipse in Hainan Island. Its early development was also influenced by the 'Great Leap Forward'. Specifically, this study focuses on the four aspects of social backgrounds of new China: the first science planning set in 1956, the 'task-oriented science development' strategy, the international background of Sino-Soviet cooperation in science and technology, and the political campaign of "Great Leap Forward". New China's first scientific development planning and the "task-oriented science development" strategy offer the blueprint and put forward the specific ways for the development of science during the period. Radio astronomy was one of the programs of planning for astronomy. The strategy of 'task-oriented science development' is a balance between national economic with scientific development, such as technology used in the task of time service started in 1955 was related to that of radio astronomy, and some of the builders of radio astronomy also took part in the same task before they were called in to start this new discipline. Sino-Soviet cooperation in science and technology is one of the effective science development strategies in the mid-twentieth century of new China, which provides convenience for the scientific development of the new China. The 1958 Sino-Russian joint observation was one of such cases through which Chinese scientists learned radio astronomy technology from the Soviet and then China established the first team on radio astronomy under the help and guidance of the Soviet union. The Campaign of 'Great Leap Forward' began in 1958. The birth and the early steps of radio astronomy also experienced the "baptism" of the 'Great Leap Forward', which interrupted the normal way of the development of this new scientific discipline.

Toshiyuki TAJIMA | National Astronomical Observatory of Japan, Japan

Aspects of the traditions of Japanese optical astronomers reflected in their efforts to develop CCD cameras

In this paper, I would like to discuss the transformation of the laboratory life of Japanese astronomers that happened in 1990s. Before that, the majority of Japanese optical astronomers believed that they should not be involved in the R&D of the observational instruments. Even so, young researchers who had impressed at the leading-edge observation technology while studying in Europe and the United States tried to develop CCD cameras in the mid-1980s. Although their project group, not having enough knowledges, skills, and experiences on dealing with such devices, was barely able to get some images of astronomical objects, their handmade camera were off from practical use. However, their situation was drastically changed in 1990s. In order to build the 8-m Subaru Telescope on Mauna Kea, support system for R&D was organized at the National Astronomical Observatory of Japan (NAOJ). At the same time, a number of scientists were transferred from other fields, such as high-energy physics and infrared astronomy to optical astronomy, to optical astronomy bringing their own style. R&D of instruments became an indispensable element of laboratory life of NAOJ astronomers. Their project team led the world in the practical realization of mosaic CCD camera in early 1990s. By comparing this successful R&D project with the effort in 1980s on the basis of interviews and written documents, I would like to shed light on the distinctive characteristics of the tradition of Japanese optical astronomers.

Vitor BONIFÁCIO | Universidade de Aveiro, Portugal

Early astronomical cinema, 1898-1918

The desire to time the 1874 transit of Venus led to the first automatic recording of a sequential series of photographs. Despite this pedigree early astronomical moving pictures are neglected by current historical accounts of the development of both cinema and astronomy. In this work we surveyed scientific astronomical moving picture attempts made before the end of World War I. One immediately realises that films were sparsely shot in the time interval studied and that solar observations were the driving force behind the majority of them. One had to wait until 1912 for the first simultaneous use of a large number of film cameras in a single astronomical observation. Following the 1912 April 17 solar eclipse the first astronomical hypothesis solely based on film data was proposed and several analyses of astronomical films were published in international journals. Despite this visibility these cinema attempts and results were quickly forgotten by the astronomical community. We suspect the wide range of professional backgrounds of early astronomical cinema pioneers did not help to establish the medium credentials at a time when the cinema role was still being defined within society. We conclude that movie cameras failed to become part of the standard astronomical observers toolkit. This was mainly a consequence of a lack of suitable observable subjects.

T161-B. Theory in early twentieth-century physics

Fri 26 July, 11:00–12:30 ▪ Schuster Blackett

Chair: Hasok CHANG | University of Cambridge, United Kingdom

Hajime INABA | Max Planck Institute for the History of Science, Germany

Max Planck and the Boltzmann principle

This paper shows that Max Planck changed the usage of the Boltzmann principle $S = k \log W$ from its original way, in which he applied the entropy expression directly into a thermodynamic relation while Boltzmann did not. The originality of my claim is based on the aspect that it focuses on the difference in the usage of the principle between the two, while the former literature has mainly emphasized on the conceptual difference. The main support for my claim is the analysis of the structure of Boltzmann's famous 1877 paper and that of Planck's investigations on black-body radiation.

In Boltzmann's writings, there are three examples in which he referred to the Boltzmann principle. First, he proposed the relation between S and W to derive the Maxwell distribution for gases in 1877, where W means ways of distributing energy into each molecule in a gas. The state with the largest value of W corresponds to the one in thermal equilibrium. By taking the continuous limit of kinetic energy, he obtained the continuous limit of S . The maximization of the limit had been already known by Boltzmann and led to the Maxwell distribution for gases. Later, in his *Lectures on gas theory* (1896), he used the principle similarly. Another example is found in the paper published in 1883, in which he applied the principle to maximize the total number of possible combinations of dissociated and undissociated molecules.

In contrast to Boltzmann, Planck adopted the strategy to combine Boltzmann's new expression of entropy with the thermodynamic relation $1/\theta = dS/dU$ without maximizing it. Planck had mastered thermodynamic methods from the very beginning of his career. It can be assumed that this experience helped him to apply the Boltzmann principle to the thermodynamic relation. For instance, in his paper "On the theory of the laws of the energy distribution in the normal spectrum" (1901), the definition of W was the number of ways to distribute energy into resonators in equilibrium, in which the unit of energy ϵ was introduced as an essential trick. The entropy determined was then substituted into the relation $1/\theta = dS/dU$, where U is the energy of

resonators and led to the Planck radiation law. This method, which is in contrast to Boltzmann's original usage of the principle, can also be found in his *Lectures on the theory of thermal radiation* (1906) and other papers.

José Ernane Carneiro CARVALHO FILHO | Universidade do Estado da Bahia (UNEB) e Faculdade Anísio Teixeira (FAT), Brazil

The reception of the theory of relativity in the French philosophical amid: a reading based on Bergson, Meyerson and Bachelard

The diffusion of the Theory of Relativity in France began with the conference held by the physicist Paul Langevin during the International Congress of Philosophy in Bologne and in the French Society of Philosophy. Due to these two conferences, the Theory of Relativity became a philosophical theme. It is in this context that the works of Henri Bergson emerged, *Durée et simultanéité*, Émile Meyerson, *La deduction relativiste*, e Gaston Bachelard, *La valour inductive de La relativité*. This works produced in the decade of 1920, implied in several interpretations of Einstein's theory. Bergson for example affirms that the several times stated by the Relativity are mathematical, that means, not real, because the only existing temporal reality is the one which is noticeable by a conscience able to embrace the before and the after, the duration. The Bergsonian duration is unique because once it is restrict to the conscience of the living and these ones have similar structures, it is possible to think that the duration is always unique. Meyerson on the other hand defends the relativistic statements, but he emphasizes that the principles of the Relativity is a continuation of the special explanation of Descartes. In its deductive face Meyerson affirms that the Relativity is related to the Hegelianism and to the cartesianism for aiming to establish a deductive global system, although he recognizes the differences on the ways followed by Einstein and Hegel. Bachelard on the other hand, uses the theory of Einstein to reformulate his temporal conception, breaking with the bergsonian duration to state that the only temporal reality is the instant in a determined point of the space-time. It also uses the Relativity to demonstrate that the realism of Meyerson doesn't have its bases on the context of this new theory. Bachelard aims to demonstrate that the Theory of Relativity besides having a deductive character explained by Meyerson, it also has a inductive feature when it makes possible the creation of new phenomena from its principles. This way, the theory of Einstein provided an intense philosophical debate in the decade of 1920, in France, where each philosopher resorted to the Relativity to emphasize its philosophical statements, as in the case of Meyerson, and to combat it, in Bergson's. Y Bachelard on the other hand, will use the new theory to construct a conception of science that broke realism as much as with the Bergsonian duration.

Christian BRACCO | University of Nice-Sophia Antipolis, France

Quanta, relativity and Einstein's dual vision of light

In the absence of any reliable document, from which Einstein's ideas on relativity prior to 1905 could uniquely be drawn, we are forced to make assumptions. If many historians (J. Norton, O. Darrigol, ...) have privileged an electromagnetic origin, others like A. Miller have emphasized the role of light quanta. I'll come back on some evidences that the March quanta have played a role in the June and September 1905 relativity papers and reciprocally that the relativity principle may have influenced Einstein's reflexions on free moving quanta. From both a scientific and an historical perspective, the association of quanta and relativity is indeed natural if one has in mind Planck's work on the black body radiation and Poincaré's contribution "*Lorentz theory and the reaction principle*" to the *Lorentz Jubilee*, which both occurred in mid-December 1900. As well known, the former introduced fixed energy quanta and the latter (quoted by Einstein in 1906) opened the way to a dynamical and relativistic (at first order in v/c) account of the

electromagnetic field behaviour. But unknown, Poincaré's paper also exhibited at this order *the same transformation law for the energy and the frequency* of an electromagnetic plane wave of finite length. If Einstein remarked this before 1906 (which is not proved), it may have encouraged his thinking of moving quanta. We would then meet the point of view expressed by R. Penrose in his preface of J. Stachel's book *Einstein's miraculous year*, that "it is virtually inconceivable that [Einstein] would have put forward two papers [March/June] in the same year which depended upon hypothetical views [particle/wave] of Nature that he felt were in contradiction with each other". March, June and September 1905 Einstein's papers would constitute a remarkable synthesis, in a fully original and new epistemological view, of Planck's 1900 work on the interaction between matter and radiation and Poincaré's 1900 paper on the relativistic dynamics of charges and the electromagnetic field.

Adrien VILA VALLS | Université de Lyon, France

Louis de Broglie et la diffusion de la mécanique quantique en France

Unique français parmi les fondateurs de la mécanique quantique, Louis de Broglie est une figure de premier plan dans l'histoire de la physique française du 20ème siècle. Il devient en particulier grâce à son prix Nobel de physique en 1929 le personnage central de la physique théorique française à partir du début des années 1930 et de lourdes responsabilités sur son développement lui sont confiées. Au fil des récits usuels portant sur la physique française du 20ème siècle, la mécanique quantique, qui structure la physique théorique depuis son apparition, est décrite comme s'étant très lentement diffusée en France, et il est souvent admis que peu de physiciens de ce pays l'utilisèrent avant la fin de la seconde guerre mondiale. Or, Louis de Broglie est souvent désigné comme le grand responsable de cet état de fait supposé. Le découvreur de la dualité onde-corpuscule pour les particules matérielles est alors dépeint comme un représentant type d'une pratique de physique théorique obsolète basée sur l'utilisation de représentations imagées naïves. Qui plus est, son rôle institutionnel et sa responsabilité dans l'isolationnisme français qui caractérise cette période est dénoncée.

Ma présentation comportera deux étapes. Premièrement, je tenterai d'éclairer les modalités de la diffusion de la mécanique quantique en France et le rôle de Louis de Broglie dans ce processus, que ce soit du point de vue purement intellectuel mais également du point de vue institutionnel. Ce faisant, mon propos visera à corriger, ou du moins nuancer, les habituels récits portant sur cet aspect de l'histoire de la physique française du 20ème siècle. Deuxièmement, je montrerai que l'essor dans des domaines tels que la physique des particules, la physique du solide et la physique nucléaire après la seconde guerre mondiale introduit un changement dans les pratiques des jeunes théoriciens qui débutent leur carrière à cette période par rapport aux types de pratiques qui régnaient alors en France autour de Louis de Broglie, notamment en raison de la nécessité impérieuse de prendre en considération une prolifération de nouvelles données expérimentales. Je serai alors en mesure de proposer une explication à la question de savoir pourquoi l'héritage de Louis de Broglie au sein de la physique française de la seconde moitié du 20ème siècle est si peu revendiqué, tout en évitant de tomber dans le piège des jugements rétrospectifs et péjoratifs.

T161-C. Techniques in modern physics

Fri 26 July, 14:00–15:30 ▪ Schuster Blackett

Chair: Graeme GOODAY | University of Leeds, United Kingdom

Wanderley VITORINO DA SILVA FILHO | Universidade Federal da Bahia-UFBA, Brazil

O desenvolvimento da pesquisa em Física da Matéria Condensada (FMC) no Estado da Bahia (Brasil)

A FMC é o ramo de pesquisa que concentra mais de 50% de físicos no mundo e no Brasil. A pesquisa em FMC no Brasil começou, em 1933, com Bernhard Gross. No ano seguinte, na então capital do Brasil (Rio de Janeiro), ele começou suas pesquisas em dielétricos no Instituto Nacional de Tecnologia (INT). O problema de pesquisa de Gross era estudar o fenômeno da absorção dielétrica (um capacitor descarregado voltava a apresentar tensão sem que fosse carregado por métodos conhecidos). Em 1942, Gross tornou-se interessado em estudar os eletretos (dielétricos carregados eletricamente). Naquele mesmo ano, Joaquim da Costa Ribeiro começou a se interessar por essas pesquisas. Enquanto Gross realizava as pesquisas no INT, Costa Ribeiro pesquisava na Universidade do Brasil (UB), criada em 1937. Gross e Costa Ribeiro eram professores de Física da Universidade do Distrito Federal (UDF) criada em 1935, pelo educador Anísio Teixeira e incorporada à UB em 1939. Costa Ribeiro foi quem iniciou as pesquisas na UDF, tendo como objeto alguns minerais radioativos. Devido à crise política ligada ao golpe de estado pelo Presidente Getúlio Vargas, Gross afastou-se da docência na UDF. Costa Ribeiro tornou-se então o responsável pelo curso de Física e continuou as pesquisas sobre radioatividade na UB e se interessou também por eletretos, passando a pesquisá-los com Gross. Pesquisando os dielétricos, Costa Ribeiro comunicou, em 1944, a descoberta de um novo fenômeno físico que ele denominou efeito Termodielétrico, o qual consistia na separação de cargas elétricas nos dielétricos durante a mudança de estado físico. Na década de 1950, alunos de Costa Ribeiro fizeram as suas iniciações científicas pesquisando o mencionado efeito. Entre estes, Sérgio Mascarenhas e Yvonne Mascarenhas foram convidados para a docência no Instituto de Física e Química da Universidade de São Paulo em São Carlos. O efeito acima mencionado, também chamado efeito Costa Ribeiro, foi investigado por quatro físicos (Benedito Pêpe, Álvaro Ramos, Felipe Serpa e Bela Serpa), que iniciaram pesquisas em FMC na década de 1960, na antiga Universidade da Bahia, contudo tal grupo não recebeu ajuda institucional e encerrou as suas atividades. Somente em 1975, as pesquisas em FMC recomeçaram na Bahia com o atual Programa de Pós-Graduação em Física (PPGFIS).

The development of research in condensed matter physics (CMP) in the state of Bahia (Brazil)

The CMP is the branch of research that concentrates more than 50% of physicists in the world and also in Brazil. Early research in CMP in Brazil began in 1933 with Bernhard Gross. In the following year, in the then capital of Brazil (Rio de Janeiro), he began his research on dielectrics at National Institute of Technology (NIT). The research problem of Gross was studying the phenomenon of the dielectric absorption (an uncharged capacitor voltage returned to present without being carried by known methods). In 1942, Gross became interested in studying electrets (electrically charged dielectrics). In that same year, Joaquim da Costa Ribeiro began to be interested in these searches. While Gross performed research in the NIT, Costa Ribeiro researching at the University of Brazil (UB) created in 1937. Gross and Costa Ribeiro were professors of Physics at the University of the Federal District (FD) created in 1935, by educator Anísio Teixeira, and incorporated to the UB in 1939. Costa Ribeiro was one who initiated the research in UFD over some radioactive minerals. Due to the political crisis linked to the coup d'état by President Getúlio Vargas, Gross moved away from teaching in the UFD. Costa Ribeiro then became the responsible for the Physics course and continued research on radioactivity in UB and also interesting for electrets, researching the same with Gross. Searching dielectrics, Costa Ribeiro announced, in 1944, the discovery of a new physical

phenomenon that he termed Thermodielectric effect, which consisted in the separation of electrical charges in the dielectric during the change of state. In the 1950s, students of Costa Ribeiro did their scientific initiations researching the effect mentioned. Among these ones, Sérgio Mascarenhas and Yvonne Mascarenhas were invited to teach at the Institute of Physics and Chemistry at University of São Paulo in São Carlos. The above mentioned effect also called Costa Ribeiro effect was investigated by four physicists (Benedito Pêpe, Álvaro Ramos, Felipe Serpa and Bela Serpa) who started researching CMP in the 1960s, at the former University of Bahia, however such research group did not receive institutional aid and closed its activities. Only in 1975 resumed the research at CMP in Bahia with the current Graduate Program in Physics PPGFIS.

This presentation is based on work co-authored by Aurino Ribeiro Filho.

Mayane L. NÓBREGA | UNIVERSIDADE FEDERAL DA BAHIA, Brazil

The development of nonlinear dynamics in Brazil, from the physicist's point of view, 1970-2000

Research on Nonlinear Dynamics began in the late 19th century with Henri Poincaré (1854-1912) who studied the 3-body problem in celestial mechanics, but only on the 20th century that this area had attracted a greater number of researchers. In the early 20th century George D. Birkhoff (1884-1944) expanded the results obtained by Poincaré and after that, the Qualitative Theory of Differential Equations had several advances in the first half of the century, specially with Russian tradition in the study of Dynamical Systems Theory. Between the late 1960s and the beginning of the 1980s, the knowledge that simple dynamical laws could give rise to complex behaviors had configured, at that time, as a scientific revolution behind the name "Chaos". Scientists like Steve Smale (1930-), David Ruelle (1935-), and Edward Lorenz (1917-2008) have developed pioneering work in this field. In the mid-1970s the study of Complex Systems attracted more and more attention of scientists, and began to fall in the popular domain by means of the popular science writers. While the history of Dynamic Systems as a topic of Mathematics has been well studied the achievements by physicists have been understudied, which is a meaningful lacuna as the physicists had an important role in this period for the establishment of this area of knowledge. As Brazilian science is concerned, the History of Mathematics well records the contributions to this field by Brazilian mathematicians such as Mauricio Peixoto but there are no historical studies about how this theme evolved in Brazilian Physics. By this time, Brazilians physicists went abroad to study this field, some of them, such as Celso Grebogi, achieved scientific prestige among his peers, and most of them returned to Brazil to continue their research. In this paper I would like to show the role played by physicists in the development of nonlinear dynamics taking the case of Brazilian physicists in the period 1970-2000, their formation and their relationship with physicists from other countries. This study was based in interviews and scientometrics analyses. As a conclusion I would like to show that, despite the delay of formation of a brazilian community dedicated to the studies of Nonlinear Dynamics, brazilian physicists had been followed the evolution of this area.

We are grateful for the comments on an earlier draft of this communication provided by Olival Freire Junior.

This presentation is based on work co-authored by Suani T. R. Pinho.

Isaac RECORD | University of Toronto, Canada

How simulations become evidence

The digital electronic computer was one of the most influential scientific instruments of the twentieth century. One of the earliest and still prominent uses is Monte Carlo simulation, a computational method that

arose during the Manhattan Project. In this paper, I trace the rise in status of Monte Carlo from its initial use in the forties as an auxiliary heuristic to the seventies, when simulation results were regularly accepted as scientific evidence. I argue that this rise in status depended on the production and communication of "practices of trust" that subsumed Monte Carlo under accepted scientific standards. Ulam, von Neumann, and Metropolis developed Monte Carlo for use in cases where analytic methods proved intractable and real experiments too dangerous or expensive. Monte Carlo was intended as merely a heuristic, a way for scientists to gain insight into intractable analytic equations so that they could be simplified for hand-calculation. But the calculations quickly came to be accepted as scientific evidence in their own right. For example, aspects of the simulation that were initially proposed as estimates or idealizations, for example the stochastic behavior of simulated neutrons, were reinterpreted as being representative of reality, leading to new hypotheses about the nature of actual neutrons. When the focus of the Manhattan Project shifted from the atomic to the hydrogen bomb—that is, from a fission to a fusion bomb—reliance on Monte Carlo evidence became even more essential, for there simply were no experimentally available instances of fusion. The question is how this initially contested method became an acceptable source of scientific evidence. I attempt to get at the answer through an analysis of the early published papers that introduced Monte Carlo to various scientific communities, which implicitly or explicitly include arguments for the acceptance of Monte Carlo results. As the method developed and spread, scientists renegotiated standards of evidence in order to include evidence from the new practice, and at the same time they modified the practice itself to be ever more compatible with existing standards. Of particular importance for the acceptance of Monte Carlo was the development and communication of the practices of trust that gave scientists confidence in the validity and appropriate use of simulation results. I detail several such practices and argue that they were co-produced with the simulation during its design.

T162. Aspects of the history of modern chemistry

Sponsoring body:

Waters Corporation

Thu 25 July, 11:00–12:30 ▪ Roscoe 2.2

Chair: Ronald BRASHEAR | Chemical Heritage Foundation, United States

Alexander RODNY | Institute for the History of Natural Science and Technology, Russian Academy of Sciences, Moscow, Russia

Этапы становления и развития профессионального сообщества химиков

На основе концепции «дисциплинарности» рассмотрен процесс становления и развития профессионального сообщества химиков. В нем можно выделить следующие этапы:

- **Додисциплинарный** (с древности). Длительный период времени носители химического знания, опыта и умения: естествоиспытатели, натурфилософы, медики и технологи были слабо связаны между собой в своей деятельности.
- **Дисциплинарный** (с 20-х гг. XIX в.). Формируется профессиональное сообщество химиков в рамках единого «научно-образовательно-технологического» комплекса.

- **Междисциплинарный** (с 40-х гг. XX в.). Химики стали массово востребованы в естественных и технических науках, а также в технологиях, выходящих за рамки традиционных химических производств.
- **Постдисциплинарный** (с XXI столетия). Химики становятся «свободными агентами» в формирующейся глобальной инновационной системе социальных сетей. Возрастает роль организаторов инновационных процессов, которые жестко не связаны с каким-либо определенным профессиональным пространством.

Следует отметить, что когнитивно-институциональные структуры, сложившиеся на каждом этапе становления и развития профессионального сообщества химиков, полностью не утрачивают своих функций, а дополняются новыми структурами следующих исторических периодов. Даже «додисциплинарная» структура может рассматриваться как прообраз «постдисциплинарной». В них отражено стремление личностного поиска инновационной проблематики.

Stages in the formation and development of the professional community of chemists

The process of formation and development of professional community of chemists is considered on the basis of the concept of “disciplinarity”. I would like to identify following stages of this process:

- **Pre-disciplinary** (from antiquity). During the long period of time carriers of chemical knowledge, experience and ability, such as natural philosophers, physicians and technologists were weakly connected among themselves in their activities.
- **Disciplinary** (since the 20th of the XIX century). The professional community of chemists was formed within the framework of “scientific-educational-technological” complex.
- **Interdisciplinary** (since the 40th of the XX century). Chemists became massively in demand in natural and engineering sciences, as well as in the technologies that go beyond the traditional chemical industry
- **Post-disciplinary** (since the XXI century). Chemists are becoming “free agents” in the emerging global innovation system of social networks. A role of organizers of innovative processes which rigidly aren’t connected with any certain professional space are increasing.

It is necessary to note that the cognitive-institutional structures which have developed at each stage of formation and development of professional community of chemists, completely don’t lose the functions, but are supplemented with new structures of the next historical periods. Even “pre-disciplinary” structure can be considered as a prototype of “post-disciplinary.” They both reflect the desire of personal search of innovation problems.

Thibaut SERVIANT-FINE | Université Claude Bernard, Lyon, France

Putting biochemistry to work: the case of the Woods-Fildes theory

In the mid-1930s, the advent of sulfa drugs offered the possibility of treating a wide range of infectious diseases and thus raised and renewed considerable hopes that medicine could be revolutionized through this newly proved power of chemotherapy. Apart from the empirical search for other effective products, many researchers attempted to understand the mechanism of action of sulphonamides in order to explain their anti-bacterial properties. In 1940 a young

biochemist, Donald D. Woods, presented consistent proofs that sulfa drugs might act by interfering with an essential metabolite, that is some substance necessary for the growth of the cell. The hypothesis that anti-bacterials might act this way had been advanced by his boss and colleague, Paul Fildes. This explanation was rapidly and widely accepted, and came to be known later as the Woods-Fildes theory. A few months later, Fildes argued in an important article that this theory could be used as “a rational approach to research in chemotherapy”. Effectively, the idea of designing drugs that could act by replacing essential metabolites quickly established a solid basis. Numerous studies were conducted at first towards finding new powerful anti-bacterials and anti-malarials, but they also went beyond the field of infectious disease since the search for potent anti-cancer drugs soon became another strong incentive. While the research into anti-metabolites as a new class of drugs encountered a lot of disillusion and some lasting therapeutic successes, some of the newly synthesized compounds developed as useful tools in the study of cellular mechanisms.

This paper aims at tracing the origins of the Woods-Fildes theory, its reception and combination with other fields of research, and its consequent use in the 1940s and early 1950s. Stemming from fundamental studies in bacterial biochemistry, the knowledge produced was adapted to fit a programme of drug research that extended to cancerous disease once it had been enriched with the results of nutritional studies. Thus, the Woods-Fildes theory served as a point of departure for the production of anti-metabolites which navigated from Petri dishes to hospital wards and other biological research groups, and between countries, academia and the pharmaceutical industry.

Nurit KIRSH | Bar-Ilan University, Israel

The second scientific career of Chaim Weizmann: a continuation or a new beginning?

Chaim Weizmann (1874-1952) was the first president of Israel, and also a chemist who published many articles and filed dozens of patents. His discovery of a method for producing acetone from corn using microorganisms is his most well-known achievement due to its contribution to the British military effort in World War I.

During the 1920s Weizmann devoted all of his efforts to Zionist political activity, resigning his scientific work. For over a decade he did not write a scientific article nor did he file a new patent. Only in the 1930s did Weizmann return to work as a chemist. In 1931 he founded a scientific laboratory in London (which was later destroyed in a German bombing), and from 1934 he divided his time between his London lab and the Ziv Institute in the Land of Israel (world-famous today as The Weizmann Institute for Science).

The scientific activity of young Chaim Weizmann, culminating in the discovery of industrial production of acetone, has been studied by historians and historians of science. However, no historical research has been done thus far on Weizmann’s scientific career from the 1930s and beyond. A situation in which a scientist disconnects from scientific endeavor and returns to it years later, when that scientific field has evolved and changed, is rare and raises a number of questions.

In our talk we will discuss the obstacles Weizmann encountered upon his return to chemistry and how he managed to reintegrate, scientifically and socially, into the researchers’ community. We will examine to what extent his studies in the later period can be seen as a continuation of studies done in the earlier period, and to what extent they reflect a change in direction. By focusing on the less familiar years of Weizmann’s scientific activity, we hope to flesh out a more complete picture of his work in chemistry and biochemistry. Moreover, in the broader sense this spotlight may help us illuminate other issues relating to the pursuit of a scientific career in chemistry during a fascinating and turbulent historical period - the first half of the twentieth century.

Nuno FIGUEIREDO | Interuniversity Center for the History of Science and Technology (CIUHCT), Faculty of Sciences, University of Lisbon, Portugal

Under the carbon spell: aspects of the history of boron hydrides, 1916-1941

The history of boron hydrides has so far evaded historical scholarship, despite the fact that they are crucial to understand the changing conceptions and models regarding the nature(s) of the chemical bond. In this presentation, I argue that boron hydrides were considered by chemists as the ultimate test for any theoretical account of the chemical bond and that wrong metaphysical assumptions originated and guided their evolution, eventually leading them to industrialization. For historians they provide a fertile ground to observe the plasticity of ideas and concepts, in their ability to be adapted and appropriated by new theoretical contexts. They further provide a paradigmatic case-study for the operative power of metaphysical assumptions in science. The structural debate alone sustained and guided research on boron hydrides. This was largely the consequence of an essential and irreducible incompatibility with Lewis' covalent bond (1916), which led many of the most prominent chemists to attempt a solution for the structure and nature of bonds in these molecules. Such was the case of Nevil V. Sidgwick, Samuel Sugden, Maurice L. Huggins, Robert Robinson, Thomas M. Lowry, Egon Wiberg, Linus Pauling, Gilbert N. Lewis, Robert S. Mulliken, Simon H. Bauer, H. C. Longuet-Higgins or Newton Lipscomb. Most of these proposals were based on the wrong assumption of an essential analogy between boron and carbon chemistries, backed by an omnipresent principle of unity that seized minds and hearts and restricted the debate over the structure of boron hydrides for a surprisingly extended period of time. These metaphysical assumptions, to which I have called "the carbon spell", would eventually prove their operative power in the development of boron chemistry. A surprising array of models and theories was put forward in the period under consideration. Among these, I address those of Egon Wiberg, Linus Pauling, Robert Mulliken and Simon H. Bauer. By doing so, I show how the dialectics between analytical chemistry, the emerging physical methods, and the theoretical quantum accounts of Linus Pauling and Robert Mulliken shaped the debate from 1930 to 1941, and how the advocates of both sides were able to seize the very same empirical data to champion their theory. I will then analyze how disciplinary commitments, interdisciplinary relations and metaphysical assumptions, eventually prevented to break the carbon spell and discover (or construct) significantly sooner the present-day model for boron hydrides.

T163. Mapping, geography and geology

Mon 22 July, 11:10–15:40 ▪ Roscoe 1.008

T163-A. The politics of mapping

Mon 22 July, 11:10–12:40 ▪ Roscoe 1.008

Chair: Paolo BRENNI | CNR, Fondazione Scienza e Tecnica, Switzerland

Paul MOHR | retired from NUI Galway, Ireland

Africa beckoning: geological exploration and mapping in nineteenth- and early twentieth-century Eritrea

The science of geology entered the future Eritrean region through the observations and publications of two German explorers, Christian Ehrenberg (1820s) and Eduard Rüppel (1830s). Areal geological mapping followed surprisingly soon thereafter, a three-year survey

(1839-42) pioneered by two French lieutenant military engineers, Adolphe Ferret and Joseph Galinier. Their 1:1 million map outlined the basic stratigraphy of the plateau in southern Eritrea and northern Ethiopia. Down in the warmth of sub-sea level Afar, Werner Münzinger mapped the evaporitic sequence of the Salt Plain when extending his Ottoman, and later British, consular duties (1860-75). During the same period, explorer Theodor von Heuglin scrutinised the basement terrain of highland Eritrea. In 1867, careful traverse mapping by William Blanford, attached to the British military expedition sent from India to confront Ethiopian Emperor Tewodros, resulted in a book on the geology and stratigraphy of the Eritrea-Wallo plateau margin, illustrated with a 1:875,000 map (1870). The establishment of the Italian colony of Eritrea in 1890 immediately spurred the mapping of its geology, accomplished by Luigi Baldacci who was London-trained and well practised from a four-year survey of the entire island of Sicily. In addition to a fine 1:400,000 geological map (1891), Baldacci initiated the practice, followed by field geologists such as Giotto Dainelli, Pietro Verri and Aldo Bibolini, of sending field samples back to Italian laboratories for some excellent mineral and rock analyses. The unexpected geology of the Red Sea hills (Dancalia) was revealed and mapped through a camel-supported survey by Paolo Vinassa de Regny (1919-20), his rock samples analysed by Maria de Angelis in Milano. During the 1930s, the Neogene sediments of coastal Eritrea were being mapped by renowned petroleum geologist Cesare Porro, while on the plateau detailed lithologic and structural mappings of areas of metamorphic basement were initiated by Antonino Francaviglia and also Ciro Andreatta. Mussolini's invasion of Ethiopia in 1935 ended all that.

SHIBUYA Shizuaki | Chubu University, Japan

Modern, private maps of Korea and Seoul City influenced by older Korean maps: the influence of Dae-dong-yo-ji-do

Before the World War II, many of the maps of Korea and its cities were made by Japanese cartographers. Many private maps started being made, especially at around the time of the First Sino-Japanese War (1894), owing to Japan's increased interest in the Korean Peninsula. However, scarcely any modern surveys were conducted in the Korean Peninsula before 1910, and owing to insufficient information, there were cases in which old maps of Korea from the Joseon period were used as a second-best policy. High-quality old maps were produced in the Korean Peninsula from the eighteenth century onward. Using maps of Korea and Seoul from around 1890 to 1910 as examples, the objective of this research report is to shed light on the influence of old maps. This research will lead to reveal the continuity between modern maps and old maps.

Among the modern maps of Korea drawn by Japanese cartographers, the first is the "Chosen-zenzu" (map of Korea), which was produced in 1875 by the Army General Staff. Private maps of Korea then started being produced during the 1890s. Because modern surveys had not been conducted, the cartographers referred to nautical charts drawn in Europe and America and maps of Asia made in Qing China, in addition to old maps of Korea. Dae-dong-yo-ji-do (map of Eastern Land,) which was the most well known of the old maps of Korea from the Joseon period, influenced a number of modern maps of Korea. In particular, the geographical information recorded in the old maps, such as topography, place names, and roads, was widely utilized by cartographers.

Maps of Seoul, on the other hand, started being drawn as sections of the modern maps of Korea. As they were large in scale, city maps were particularly difficult to make in a time when modern surveys had not yet been conducted. For this reason, simplistic old maps containing scarce information were initially used. Later, the "Han-yang-do" (map of Seoul), which appeared in the Dae-dong-yo-ji-do, became widely used. Until modern surveys started being conducted, most of the maps of Seoul made by Japanese cartographers were based on the Han-yang-do.

Sophie BROCKMANN | University of Cambridge / MPIWG, Berlin, United Kingdom

Colonial structures, independent policies: geographical and natural-historical knowledge in independent Central America

In the newly-independent Central American Federation (1821-1841), as in other Latin American countries, mapping projects, as well as archaeological and natural-historical research, were instrumental in the state's project to define the emerging nation. This paper analyses these projects in relation to its colonial antecedents, chiefly the expansion of Guatemala's connection with international knowledge networks. The independence-era expeditions and projects were characterised by a reliance on, and a reinterpretation of, the knowledge networks that had formed the basis of colonial-era institutions such as the 'Economic Society of the Friends of the Country' and merchant guilds. The Central American state sought to define its boundaries and natural resources through projects such as the Atlas Guatemalteco (1832), as well as the plans drawn up by José del Valle for an international natural-historical expedition to explore Central America. In addition, a network of new roads, and the increasingly professional exploration of Maya ruins, also required engineers and prospectors to travel around the country. All of this formed notable continuities as well as contrasts with the colonial-era efforts to gather natural historical and geographical knowledge about Central America, both by the government, and by the 'Economic Society'. This paper analyses the Central American Federation's cartographic, archaeological and natural-historical projects with regards to the role played by foreign engineers, prospectors and travellers. Of particular interest is the attitude of Guatemalans towards the expertise of these foreigners, especially in the light of colonial-era knowledge networks drawing on foreign expertise, but also heated proto-nationalist debates on the epistemological value of Guatemalan, rather than foreign, knowledge. The current historiography tends to focus on these projects as a part of the emergence of the Guatemalan nation from the wider Central American Federation, emphasising the rupture of the independent state with the past. By contrast, this paper focuses on continuities of information networks and epistemology between the colonial and independent periods.

T163-B. Geological travels

Mon 22 July, 14:10–15:40 ▪ Roscoe 1.008

Chair: Leucha VENEER | University of Manchester, United Kingdom

BESSUDNOVA Zoya | Vernadsky State Geological Museum, Russia

The mineralogist Nikolai Koksharov (1818-1892) and his field trips with Roderick Murchison in Russia, 1840-1841

Nikolai Koksharov (1818–1893) was born into the family of a mining engineer. In 1822, his father was appointed head of the Berezovsk gold mine in the Middle Urals, and his family moved there. In 1840, he graduated with distinction from the Mining Institute in St Petersburg, at that time a part of Russia's military system.

In 1840, an expedition was organized and financed by the Russian Government to examine the major geological features of the European part of Russia and the Urals. The British geologist Roderick Murchison headed the expedition and the young officer and mineralogist Koksharov was ordered to accompany the famous visitor. He became familiar with Murchison's field methods and improved his own knowledge of geology. The expedition lasted ten weeks.

Nikolai's first geological article, 'Geognostical (geological) notes on several regions of European Russia', was published in 1840 in *Gorny Zhurnal* (*Mining Magazine*). There, he demonstrated his own views,

which were in some respects at odds with those of Murchison on the geology of the northwestern part of European Russia. Koksharov wrote that the layers of clay (later classified as Permian) lie on the Mountain Limestone (now Carboniferous).

In 1841, Koksharov was required to join a further expedition with Murchison and de Verneuil and accompany them from St Petersburg to Perm and beyond. The expedition proceeded from Orenburg, close to the border with Kazakhstan, to the southern areas of the Russian Empire. However, Murchison asked Koksharov to return to Orenburg to clarify some details of the local geology there. Koksharov did so, but failed to get the necessary authorization from the army, and this cost him his decoration for his work with the Murchison expeditions. In 1890, Koksharov wrote about this episode in his *Reminiscences* (1890).

In his Journal, Murchison described Koksharov as young, enthusiastic and likeable. In his report, Murchison wrote: "Koksharov's support contributed to the success of the expedition and our efforts". Subsequently, he became a distinguished mineralogist and author of the multi-volume *Data on the Mineralogy of Russia*.

Renee CLARY | Mississippi State University, United States

The journey from elite society to government geologist: Henry De la Beche's powerful impact on the importance of observation within an emerging professional science

Henry De la Beche (1796-1855) entered the scientific realm within an elite group of gentleman geologists. As a firm advocate of observation, De la Beche's philosophy of science involved the collection of facts, from which satisfactory theories or solutions to geological problems could only arise after accumulated observations were compiled (1825, 1827). De la Beche authored many texts, but insisted that he recorded only facts and did not support any particular theory, which often relied on scant observation (1830).

De la Beche's role within elite society changed when his finances began to flounder. However, De la Beche's persistence at procuring government support for his mapping projects resulted in his eventual appointment (1835) as director of Britain's Ordnance Geological Survey, the forerunner to the British Geological Survey. As a government scientist, De la Beche maintained a staunch advocacy of observation. He used his position to promote field work, and ensured quality in the deliberate recording of accurate information. De la Beche provided clear instructions to local survey directors, and advocated a "general mode of observing and recording facts" for "systematic investigations and uniformity of results" (1845). His methods guaranteed that facts, and not selective interpretations, would be available for those who needed them.

De la Beche insisted that utilitarian geological products, such as survey maps and mining records, were consistent and of high quality. He promoted the importance of these products—and the field work that produced them—within the elite societies of which he remained a member. Through his government position, De la Beche successfully advocated for public displays of facts and collections, and largely through his efforts the Museum of Practical Geology, the School of Mines, and the Mining Record Office were established.

Therefore, De la Beche's emphasis of observation over theory had far-reaching impact in the emerging Victorian professionalization of science. Although he lost personal funding and could not sustain an elite participation in the emerging geological discipline, his government position provided a powerful platform from which he was able to teach, systematize, and institutionalize field-based geological observation. De la Beche's success is measured through the establishment of fact repositories in Great Britain, and also through the impact that surveyors who studied his field methods brought to other countries.

This presentation is based on work co-authored by James Wandersee.

John DIEMER | University of North Carolina at Charlotte, United States

Murchison in Sweden: an example of collaborative geologic mapping

A notable product of the geologic work of Roderick Murchison was the geologic map accompanying the landmark book *The Geology of Russia in Europe and the Ural Mountains* (John Murray, 1845). Much of that map resulted from extended field campaigns undertaken by Murchison and colleagues in Russia in 1840 and 1841. Other portions of the map were compiled between 1842 and 1845 based on additional trips made to Poland and Scandinavia. The production of this comprehensive map was made possible by a fieldwork methodology that Murchison had developed and used throughout his career. The methodology comprised research and correspondence in advance of a trip, assembly of publications and maps covering the area to be investigated, networking with local experts and examination of their fossil collections and geologic maps, traveling with other geologists to collaborate on fieldwork, detailed record-keeping of observations, and prompt announcement of results both at meetings and in print. A good example of this methodology in action is Murchison's fieldwork in Sweden. In 1844 Murchison traveled to southern Sweden and documented the occurrence of Lower Silurian fossiliferous sedimentary rocks resting unconformably on crystalline basement. He made those observations at Kinnekulle and the Billingen Hills whilst traveling with the Swedish geologist, Sven Loven. Together with Edouard de Verneuil, Murchison returned to Sweden in 1845 and their itinerary was strongly influenced by Wilhelm Hisinger's geologic map. During that summer, they traveled to Lake Siljan, the island of Gotland, and the southern coast of Sweden. They recognized both Lower and Upper Silurian rocks at these localities and were able to correlate the much thinner rock units of Sweden to equivalent, but thicker, rock units in Britain based on similar fossil content. They were the first to apply the modern system name Silurian to these rocks that until then had been known only by Swedish names of local significance. Many of their findings were first announced at the Geological Society. Part of the Swedish work was published in *The Geology of Russia* (1845); additional papers on drift and bedrock geology were published in the *Quarterly Journal of the Geological Society*. Collaborating geologists benefited from interacting with Murchison and they typically remained on good terms long after the work was completed.

T165. Contexts of natural history

Tue 23 July, 09:00–17:30 • Uni Place 3.204

T165-A. Botany books and careers in the eighteenth and nineteenth centuries

Tue 23 July, 09:00–10:30 • Uni Place 3.204

Chair: Peter BOWLER | Queen's University Belfast, United Kingdom

Isabelle CHARMANTIER | University of Exeter, United Kingdom

Carl Linnaeus's *Materia medica*

The Swedish naturalist Carl Linnaeus (1707-1778) is best known as a botanist, for his revolutionary system of classifying plants and his new nomenclature. But Linnaeus trained first and foremost as a physician, and practiced for several years as a doctor in Stockholm in the early 1740s. Even when he was established as professor of botany in Uppsala, Linnaeus continued to investigate plants for their medicinal properties. His *materia medica* came to form an intricate part of his search for a natural system of plants based on their affinities. Indeed,

Linnaeus was one of the first to suggest that 'natural' plant genera and families share similar pharmaceutical virtues, and that herbal drugs might be sought out on that basis. The numerous notebooks, manuscripts and printed works he annotated on *materia medica* are now kept at the Linnean Society in London. They include the manuscripts and notebooks in preparation for the works published as *Materia Medica* (1749), *Genera Morborum* (1763), *Clavis Medicinae* (1766), as well as a score of monographs (such as *Vires Plantarum*, 1747) and various other prescriptions and loose notes. They provide an excellent opportunity to investigate the links Linnaeus made between natural history and medical knowledge, two disciplines that he would probably not have recognised as distinct, and how his day-to-day work practices influenced his medical ideas. It will also throw some light on the role of *materia medica* in the broader history of taxonomy in the second half of the eighteenth century.

Jenny BECKMAN | Uppsala University, Sweden

Handbooks and the making or breaking of scientific careers

In 1820, Carl Hartman published a "Handbook of the Flora of Scandinavia", which went through twelve successful editions and soon acquired the status of standard reference flora for Swedish botanists on all levels. Apart from botanical renown, the handbook provided a welcome addition to the fairly meagre income of a district medical officer. Hartman tried the same stratagem in the field of medicine, publishing "The family doctor" in 1828, a book of popular medicine. This, although commercially successful, was widely criticised by his fellow physicians. Hartman's career and his publications illustrate the difficulties as well as the opportunities created by a growing – albeit slowly – professional arena for science (Shapin 2008, Desmond 2001). These were contested issues in the emergence of modern universities and secondary schools in the decades after 1800, when the wider availability of printed textbooks and manuals challenged the role of lecturers. The writing of textbooks and handbooks was, nevertheless, a crucial tool for establishing a scientific career in the early 19th-century, making it possible to make a living and gain a following, while at the same time potentially undermining the teaching monopoly of schools and universities. In this paper I want to talk about how publishing for a wide audience served as a tool for furthering botanical careers in Sweden during the first half of the nineteenth century, when employment prospects in science were poor (cf Secord 2002). Through the "Handbook", Hartman reached a wide audience of botanists, from schools to universities as well as outside the education system, and he gained recognition from his professional peers. In the field of medicine, however, medical handbooks – even when written by physicians – were seen as a threat to the authority of the profession. The contrast with medicine highlights the norms and practices (cf Daston 1995) of what may not have been a profession, but was an increasingly workable scientific career.

Lucie ČERMÁKOVÁ | Department of Philosophy and History of Science, Charles University, Prague, Czech Republic

Using senses in sixteenth-century plant description

According to the Aristotelian tradition every living being has at least one sense – touch. That's why touch is the basic sense in the relation to the existence of animals (or man). Taste has a similar status, because it is a kind of touch (Aristotle, *De anima*, II, 3 414b; III, 12 434b). But when it comes to the ability to acquire knowledge, sight is the most appreciated sense (Aristotle, *Methaphysics*, I, 1 980a) (Lindberg, D. C., Steneck, N. H.: *The Sense of Vision and the Origin of Modern Science*. In: Debus, A. G. (ed.): *Science, Medicine and Society in the Renaissance*. London: Heinemann, 1972).

This paper will show, that we can find the different appreciation of senses also in the 16th century botanical treatises and that using senses in plant description is dependent on the aim for which the particular description is made.

First of all, there is the practical, medicinal purpose for studying, recognizing and describing plants. Renaissance opinions about plant composition and their healing powers are mostly based on the ancient four element theory: each plant is compound of water, air, earth and fire in particular proportion. The healing properties of each plant can be derived from this composition. The best way to recognize this composition is by taste, because during tasting the tongue touches directly (without any medium) the object (Aristotle, *De anima*, II, 10 422a; III, 13 434b). So that is why tastes were important part of plant descriptions.

But during the 16th century a new approach to plants emerged. They started to be studied independently of medicine as a part of newly constituted discipline. The aim of this discipline was precise description, which would allow to exactly determinate the particular plant, not just to determinate it's healing powers. In this case tastes were usually understood as accidental signs and there is was more emphasis given on the visual side of the description - the shapes, forms and the number, which in following periods also allowed to classify plants and made the first systems of plant kingdom.

Specific features of the 16th century plant descriptions will be shown on the example of some editions of Mattioli's herbal – one of the most popular renaissance botanical-medical treatises. And on the other hand on some rather methodological works, where medicine is completely omitted, like the treatise of Adam Zaluziansky ze Zaluzian *Methodi herbariae libri tres* (Prague, 1592).

Caroline GILLAN | National University of Ireland, Galway, Ireland

Ties of gratitude: the relationship between patron and client

The aim of this paper is to shed new light on the relationship between a patron and his client. The patronage system was a mutually beneficial arrangement which allowed both patron and client to benefit socially, economically and intellectually. I will examine the career of Sir John Hill, a man of many professions and a prolific writer on botany, and his patron, the Earl of Bute. I will also explore the financial dependency of individuals on wealthy patrons for advancement and somewhat fickle nature of patronage. I will begin by discussing the early career of Hill (1742-1756), his publications, dedications and his varied attempts to gain patronage. It was generally difficult for scientific clients to find patrons, so I will investigate Hill's other means of supplementing his income, which included collecting plant specimens and selling medicinal remedies. Hill was able to secure the patronage of Bute through his dedication of Eden, or, a compleat body of gardening in 1757 to the Earl. I will examine how Hill benefitted by Bute's patronage and his connection to other more influential patrons. Correspondence between the pair indicates that Hill undertook the writing of his magnum opus, *The Vegetable System* (1759-1775), at Bute's request. *The Vegetable System* consists of 26 folio volumes and 1600 copper plates and was undertaken at considerable expense by Hill. This correspondence also shows that Hill expected to be provided with financial assistance for this 'great work'. Surprisingly, even after gaining the patronage of Bute, Hill continued to dedicate work to other influential patrons, including the Prince of Wales, the future George III. It appears that although Bute wrote and encouraged Hill in writing *The Vegetable System*, he may not have provided Hill with sufficient financial compensation. After Hill's death, his wife published *An Address to the Public* which was an appeal to Bute for thousands of pounds which she claimed was owed to her husband. I will contend that even after gaining patronage, Hill found his scientific career and his financial status fraught with many difficulties.

T165-B. Spaces and places of natural history

Tue 23 July, 11:00–12:30 • Uni Place 3.204

Chair: Alexandra COOK | University of Hong Kong, Hong Kong

Hanna HODACS | Royal Swedish Academy of Science, United Kingdom

Understanding tea from China in eighteenth-century Europe

What can tea tell us about how knowledge of the natural world moved between China and Europe in the 18th century? Two contradictory stories

seem to exist. One is about naturalists failing to orchestrate planned transfers of the tea bush. This species was only successfully re-located in the early 19th century (and initially only within Asia), in spite of multiple attempts to bring seeds and seedlings to Europe and the Atlantic world. Meanwhile, however, there is another story about the exponential growth in knowledge about different varieties and qualities of tea as a consumer good in Europe, in response to the growing imports of Chinese tea by the European East India Companies. In my paper I will analyze the overlapping stories of how knowledge about the tea plant, its cultivation and the different qualities of the finished product moved between Asia and Europe in the 18th century.

Anto LEIKOLA | University of Helsinki, Finland

Pehr Kalm: the eighteenth-century traveller in America and the father of ecology in Finland

Pehr Kalm (1716-1779) was the most renowned Finnish naturalist of his time, and he has been rightly called "the father of ecology in Finland". He studied at Turku in the university "Academia Aboensis" (now the University of Helsinki) and then at Uppsala under the famous Carl Linnaeus. In 1747 he was appointed the first professor of economics of the "Aboensis", but before entering the office he made an important research trip to North America, exhorted by Linnaeus and supported by the newly-founded Royal Swedish Academy of Sciences. During the voyage he was in close contact with Benjamin Franklin, who published Kalm's description of the Niagara Falls in his magazine. After returning to Turku he tried systematically, although mainly unsuccessfully, to cultivate the plants he had brought from America, and published his travel account "En Resa til Norra America" in three volumes in 1753-1761. Three more volumes were planned and partly written, but the manuscripts and parts of Kalm's journal perished in the great fire of Turku in 1827. As professor, Kalm published with his students about 150 dissertations on agriculture, gardening, forestry, and other useful subjects. The travel book was translated into different European languages - German, Dutch, English - already during Kalm's lifetime, later also as abridged versions into French and Finnish. Kalm's work and legacy have been actively studied in the 1900s, and recently Dr. Rosemarie Tsubaki has been able to reconstruct those parts of his voyage which are lacking in his diary and travel book.

Nadezhda YUSUPOVA | European University at St.Petersburg, Russia

WITHDRAWN: The diaries of a traveler as a historical source: Pyotr Kozlov's journals of the expedition to Mongolia and Sichuan, 1907-1909

T165-C. Local contexts for natural history

Tue 23 July, 14:00–15:30 • Uni Place 3.204

Chair: Anne SECORD | University of Cambridge, United Kingdom

ARENA Libera Paola | Università degli Studi di Bari, Italy

Field experiments on the Plinian source (Torno, Lake Como): Carlo Amoretti and the different explanations of its irregular flow from the two Plinys to nowadays

Located near Torno, on the east side of the western branch of Como Lake, the Plinian source attracted the scientific attention of many scholars, famous and even less-known, through the time. To explain the phenomenon they made many fieldwork experiment using different instrument and scientific models.

The peculiarity of this source, that, even today, flows from the Plinian Villa, built in 1570 by Count Anguissola as a refuge after his involvement in the Farnese Duke death, is its particular intermittent flow. It was found that the rate of the water flow change even several times a day. What is the cause of this singular irregularities?

This question was so interesting, from the hydrological, geological and physical aspects, that, even nowadays, it's the subject of many studies and analysis, as shown a recent work base on the scientific data collected from the ancient time.

The first who described this phenomenon were the two Plinii, the Old and the Young; after Kircher, Leonardo da Vinci, Ghezzi and many other scholars of the 18th and 19th century, have done field studies to give a plausible answer.

Several explanations have been given over the centuries and all of them were analyzed by Carlo Amoretti, a prolific ligurian polygraph and a 'curious' investigator of the nature, who lived between 18th and 19th century. Even if he was a less known scholar than many other of his time, Amoretti was able to spreading the interest on different fields of knowledge, observing and descibing many different scientific phenomena.

This was also the case of the Plinian source, where he went several times during his many trips to Como Lake in order to understand, on the field, this 'mysterious' phenomenon.

So, after considering the hypothesis proposed by predecessors and contemporaries, Amoretti was persuaded that the particular geological conformation of the mountains above the source, rich in caves and crevices, allowed the wind to enter inside, causing the irregularity of the flow. To test his idea, he made speleological explorations entering into some of the Vallassina's caves, in the mountains between the two branches of the Como Lake, such as the Gravinata cave. In one of this speleological trips Amoretti went with Alessandro Volta, famous italian physicist.

The study of Plinian source is, therefore, an example of how the fieldwork explorations, especially in the 18th and 19th century, have been a powerful tool for the geologic and nature knowledge of the landscape.

Patience SCHELL | University of Aberdeen, United Kingdom

Cultivating natural history in nineteenth-century Chile

When Chileans won independence from Spain in 1818, the country had limited scientific expertise, no natural sciences institutions, no popular natural history tradition and even the government had little knowledge of Chile's natural environment. By the time the century ended, Chile boasted multiple natural history museums, government-funded research, formal training in the natural sciences, flourishing local scientific societies and internationally-known publications on Chilean natural history. This natural history culture flourished thanks to collaboration between career-minded naturalists, for whom Chile's 'unexplored' status proved irresistible, and non-naturalist supporters, for whom fostering the natural sciences aided national progress. From positions within the government, these supporters made the case again and again that the state had a responsibility to, and would benefit from, natural history. In this collaboration, three foreigners stand out: French Claudio Gay,

Venezuelan Andrés Bello and Prussian Rodolfo Philippi. In 1830, the government contracted Gay to survey Chile, write the country's natural history and found a museum. This work lasted the rest of his life, and his publications trained Chile's literate public in natural history. Bello was an important advocate of natural history, supporting the field through various government roles and translating and disseminating natural history writing. Philippi, director of the museum Gay founded for four decades, built the collections, sponsored scientific expeditions and published his results, both nationally and internationally.

But the creation of a natural history culture extended beyond an elite, as it was also based on the efforts of natural history enthusiasts and hobby collaborators, whose reward came from participation in a community of like-minded naturalists, and who founded amateur societies and scoured the countryside for personal and public collections. This paper also discusses the work of local natural history communities, whose members presented their findings at amateur societies, founded regional museums and acted as suppliers for national and international exchange networks. All these naturalists worked in an environment in which Chile sought to establish itself as a continental power, in which the natural environment became a component of national identity and in which success in the natural sciences contributed to national pride.

JEON Hyeri | Seoul National University, Korea, Republic of

How the literati in Chōsun understood Zhu Xi's comment on 'fossils'

Zhu Xi's famous comment on "seashells on high mountain(高山有螺蚌殼)" used to be compared with the principle of fossilization in modern science and praised as an accomplishment of Chinese science. These comparisons and compliments has been criticized by many historians and now it is clear that looking for the similarity to modern concept of fossil is inappropriate to show the significance of Zhu Xi's comment on seashells. Instead, the comment can be properly considered as an explanation to rationalize seashells on high mountain in Confucian cosmological principles. This paper examines how literati of Chōsun understand Zhu Xi's comment on seashells in 16th-18th century Korea. Why did they gave attention to Zhu Xi's comment on seashells? How did they utilize the comment in their writings and for what purpose? Answering these questions, I will suggest that the understanding of Zhu Xi's comment in Chōsun was associated the discourse of "odd things" often doubted to be existed since 'the past universe(先天地)'. Zhu Xi's comment on seashells was frequently quoted in Chōsun literati's essays. In these writings, however, emphasizing on the specific oddity of sea organism found in mountain vanished. Instead, the comment on seashells was referred to more broad and vague oddities, for example, various kinds of oddly-shaped stones found in nature. Some used Zhu Xi's comment to argue that those odd stones existed even before the dawn of the universe. Notions of the existence of things from the former universe didn't allow any further possible explanation for the formation of them. Chang Hyōngwang(張顯光, 1554-1637), in his essay 'On the Universe', criticized the irrational belief of existence of things from the past universe and suggested his own explanation for the formation of seashells on mountain. Chang apparently criticized Zhu Xi's comment, at the same time he elaborated the cosmological principles in exact same way of Zhu Xi's.

T165-D. Animals, monsters, and culture

Tue 23 July, 16:00–17:30 • Uni Place 3.204

Chair: Peter COLLINS | Royal Society, United Kingdom

Helena EKERHOLM | The Centre for History of Science, The Royal Swedish Academy of Sciences, Sweden

Getting to know ocean creatures in the nineteenth century: marine zoologists, fishermen and beach tourists making knowledge

In the first half of the 19th century natural historians aimed to demystify the oceans. This endeavour was complicated by the fact that the sea is an extreme environment as far as the human physique is concerned. Appropriate research sites were geographically and methodologically inaccessible to the natural historians who lacked sufficient practical know-how to undertake scientific observations. Directing the scientific gaze into the deep required some visual aid. Early marine zoology research relied on the practical know-how and observations of professional sea-farers and objects that were found near or on land. In this paper, I discuss the practical reality of marine field research in an area where three ocean activities – research, work and play – intermingled in a social as well as epistemological sense: Gullmarn, a fiord on the Swedish west coast, where the Baltic Sea meets the Atlantic. In the 1830s, this traditional fishing region attracted its first marine researchers. From then on, international and national scientific interest for Gullmarn's fauna grew. In 1876/77 a research station was established on location, but during the preceding decades, visiting researchers were dependent on the knowledge and equipment of local fishermen and other sea labourers. Science historian Helen M. Rozwadowski has argued that 19th century knowledge of the oceans should not only be understood from work as a central category, but also through 'play', i.e. beach tourism and recreation. Indeed, parallel to increased research, Gullmarn also became increasingly popular as an ocean resort for well-to-do city dwellers with an interest in the sea. Although with an ocean in common, the participants in this process of knowledge-making represented social and epistemological categories with each their own vested interests in and motives for understanding the sea and its inhabitants. With specific focus on the research of marine zoologist Sven Lovén (1809-1895), I will discuss the nature of the diverse roles and interests by Gullmarn, and which consequences it had for knowledge-claims about and definitions of regional marine life. I will also discuss role dynamics, i.e. how Lovén's research was conducted in regards to aforementioned categories and social status.

James HALL | University of Cambridge, United Kingdom

The spectacle of the serpent in late eighteenth- and early nineteenth-century London

This paper will explore ways in which snakes, whole or fragmentary, living or dead, were encountered in London between 1750 and 1840. It will consider the methods of preservation, arrangement and the context of display, and will examine the ways in which prior knowledge about snakes was used in the construction of displays, and how in turn a variety of audiences learned about snakes through non-textual encounter.

Whilst prosopographic accounts of animals have become more common of late, there has hitherto frequently been an emphasis on large, impressive or popular animals. In my wider research, I have deliberately set out to examine a type of animal that has historically elicited feelings of revulsion and fear, at least in the West. I am particularly interested in the development and persistence of stereotypes regarding snakes in the nineteenth century, especially relating to their cultural associations, within an imperial context. I am interested in how knowledge about snakes was created, acquired, transported, modified, and disseminated, and in the relationship between 'scientific' and 'non-scientific' knowledge-making, and the recycling of anecdote.

I will examine the 'museo-exhibitionary' complex at the end of the eighteenth and beginning of the nineteenth centuries to explore tensions between education and entertainment, competition and collaboration, and static and dynamic display. The late eighteenth century saw an increase in the size and formality of natural history collections, but alongside snakes in jars or taxidermied examples, skins still decorated walls, and skulls and rattles retained value as curios. Constrictor snakes

were popular constituents of travelling menageries. The early decades of the nineteenth century saw a rise in the display of living snakes with increasingly dramatic advertisements boasting of the length, rarity, and fierceness of their star attractions, and a growing taste for seeing snakes feed on living prey, with some controversy. Post-mortem, many menagerie snakes were supplied to naturalists and re-constituted as specimens and skeletons in collections such as those of the Hunterian Museum. Whilst one of the substantial advantages of menageries was the opportunity for a more comprehensive sensory encounter with animals beyond the visual, a desire and opportunity for tactile interaction sometimes led to tragic consequences. In these cases, the deceased themselves became objects of great medical and scientific interest.

Alistair SPONSEL | Vanderbilt University, United States

From threatening to threatened: coral reefs as objects of scientific study

This paper traces changing attitudes to the formation and death of coral reefs from the late-eighteenth century to the recent past. I argue that these shifts were due in large part to changes in the scientific understanding of coral growth that were driven by shifts in the ways in which scientists accessed the ocean. I examine these ideas and their consequences, as indicated by the thoughts and actions of a range of individuals, including naval administrators, navigators, zoologists, geologists, and religious and environmental writers. I contrast the present view of coral reefs as fragile systems with the widespread nineteenth-century notion (exemplified by the 1853 lament by the British geologist Roderick Impey Murchison that "no human power can arrest the growth of [coral] reefs") that reef growth was inexorable and undesirable. I argue that these alternate perspectives embody the two extremes of a shift from interpreting organic/ecological complexity as a sign of resiliency to understanding "delicate" complexity as a mark of fragility. I conclude by attending to the relatively new concept of the "death" of a reef, arguing that this description (or metaphor) was linked not only to environmentalist concerns of the late-twentieth century but to SCUBA and the other technologies that helped their users in the flourishing practice of marine biology to equate the reef with its actively growing portion rather than with the entire (mostly dead) geological reef structure.

T166. Eighteenth- and nineteenth-century biological sciences

Fri 26 July, 09:00–15:30 • Roscoe 1.007

T166-A. Networks of circulation and exchange

Fri 26 July, 09:00–10:30 • Roscoe 1.007

Chair: Marsha RICHMOND | Wayne State University, United States

César LORENZANO | Universidad Nacional de Tres de Febrero, Argentina

The cell and tissue culture technique in Giuseppe Levi's institute

At Athens I presented the story of a fourth researcher trained by Giuseppe Levi that is never mentioned by the other three disciples -all Nobel laureates- and that is virtually unknown to historians of science. I mentioned that Eugenia Sacerdote de Lustig -the fourth researcher, cousin of Rita Levi Montalcini-, had to exile to Argentina due to Mussolini's racial laws, where she continued investigating and teaching

till her death in 2011. In this occasion, I will continue that history and answering some questions that emerged in that research, mainly referred to the central role played by the tissue and cells culture technique in their histories. ¿When it was developed in Levi's institute? ¿How the technique passes from Alexis Carrel's laboratory in New York to Turin? ¿How it was used by Levi's disciples? ¿Who was Hertha Meyer? The task was not always easy. On one hand there was a large amount of information from numerous interviews, and autobiographical notes. On the other hand I had to fill gaps and inaccuracies. With regard to Eugenia de Lustig, the first woman accepted as a member of the National Research Council of Argentina –CONICET-, I will mention some of her disciples –most of them women-, and their scientific findings. Responding to a question stated in the previous Congress, I will mention how many women are principal researchers of the National Research Council.

Fernando LUNA | Northern Rio de Janeiro State University, Brazil

A case study on the flow of information about medicinal plants between Europe and South America in the eighteenth century

Recent historiography on the acquisition and accumulation of pharmaceutical knowledge by Europeans in the New World has emphasized the idea that researchers should be careful to describe exactly how knowledge was being transferred—in both intellectual and material terms—, especially if one aims to understand how science traveled and was translated between different cultures and languages from Europe and its American colonies.

In this case study, three men, namely, the Brazilian botanist José Mariano da Conceição Veloso (1741-1811), the French explorer Charles Marie de la Condamine (1701-74), and the English naturalist John Hawkins (1761-1841), and three species of plant will be discussed. The plants are, according to current nomenclature, *Myroxylon balsamum*, *Cinchona officinalis* and *Baccharis trimera*.

In 1735 during his expedition to Peru, la Condamine located and acquired several young plants from the region where the species from which Jesuit's bark was extracted had been originally found, and sent them to scientific societies in Europe. More than half a century later, John Hawkins found one of those samples, kept in the Royal Society, and published an article in which he identified the species as *Myroxylon balsamum*.

Right after that, in Lisbon, while preparing a monograph about different species of quinas which could be found in South America, Veloso read Hawkins' botanical description and, disagreeing with the attribution he had made, reassigned it to the species currently known as *Baccharis trimera*, a plant also native to Peru and the Central South regions of Brazil.

This case study shows an example of the flow of scientific information between Europe and America during the late Enlightenment period, when knowledge about the medicinal plant *Baccharis trimera*, native of South America, travelled twice across the Atlantic. First the knowledge crossed the Atlantic eastward in the form of a botanical specimen collected in Spanish America, during a French-led expedition, and reached an English botanist, who had it published in the journal from a learned London society. Then the botanical information about the plant made the return trip to South America in the form of a description together with two plates published in a book printed in Lisbon by a Brazilian botanist, whose purpose was to disseminate utilitarian information to the colonials settled in Brazil.

James POSKETT | University of Cambridge, United Kingdom

Skulls in the snow: the passage of nineteenth-century Inuit crania

Whilst he was ambling around the Inuit settlements on the Upper Savage Islands, Captain Parry came across a human skull. This was just one of the six Inuit crania that would reach the Edinburgh Phrenological

Society by 1834. Ostensibly, these skulls all came from the same place: at least according to the phrenologists, they were all 'Esquimaux', originating from the Arctic region around Davis Strait and Baffin Bay. However, to accept this claim is to privilege a static understanding of locality, one in which the work of transit is absent. In this paper, I uncover how Inuit crania moved along different social and physical routes in their passage from the Arctic towards Europe and the USA. Some of these skulls were collected by Danish colonialists, others by Royal Navy explorers and the rest by commercial whalers. By emphasising different routes, I am able to identify four distinct ways in which transit influenced the phrenologists' understanding of Inuit skulls.

First, each skull entered the exchange network in a different manner. Some skulls were robbed from Inuit graves, whereas others were traded for. Second, different routes represented different seasons. Prior to the 1850s, whalers rarely overwintered in the Arctic. As such, prolonged contact with the Inuit was uncommon. In contrast, Danish colonialists occupied the west coast of Greenland all year round. These seasonal differences influenced the content of the accounts which accompanied each skull. Third, each skull exited the exchange network in a different way. Some skulls were delivered in boxes alongside other natural history specimens, whereas others were delivered unboxed by hand. Finally, each route brought with it a distinct form of Inuit agency. When Parry collected skulls, the Inuit occasionally helped him. Indeed, as oral histories have revealed, some of the Inuit interpreted Parry's practice in terms of their own creation story. In other situations, such as in the case of grave robbing, native agency was absent. Ultimately, my paper reveals a broader need to study collecting without privileging static notions of place, particularly those implicit in the terms 'core' and the 'periphery'.

Carol PAL | Bennington College, United States

Information factory: circulating science in the seventeenth century

Information Factory: Circulating Science in the Seventeenth Century

What did it mean to be the "author" of a scholarly work in the seventeenth century? The answer could be surprisingly elusive. Focusing on the texts that emerged in multiple formats under the intellectual brand name of "Samuel Hartlib," this paper emphasizes the complex interplay of form and function in the circulation of scientific knowledge.

In 1638, the mathematician John Pell was writing a treatise on the methodizing of mathematical knowledge, but did not deem it ready for publication – so he sent it to a friend for advice. Soon, an anonymous tract began making the rounds of the republic of letters. It was Pell's, and he was forced to reveal himself as its author. In 1636, the educational reformer Jan Amos Comenius jotted down his ideas on universal knowledge, and sent a rough draft to a friend in order to get his advice. After several months of silence, he received a box containing copies of a pamphlet – lo and behold, it was his own. In 1645, the Hebrew scholar Dorothy Moore wrote a series of letters examining the implications of marriage for brothers and sisters in Christ. Before sending them to her correspondent, she first sent them to friend. Lo and behold, her "undigested" words began making the rounds as a published pamphlet.

Each of these scholars had sent their material to the same friend – the intelligencer Samuel Hartlib. All were highly annoyed at having their work rushed into print. Yet these three scholars, and scores of others, would continue sending their work to Hartlib, knowing that the fate of their words lay in his hands. Their texts might be excerpted, copied, circulated, or stored. They might be translated, annotated, collated, or printed. And in whatever form they took, they would most likely emerge under the name of "Hartlib."

Hartlib's network functioned as an information factory in the republic of letters, and his name became its corporate intellectual brand. This paper examines that cooperative phenomenon, analyzing and exploring the

choices made by early modern scholars in balancing form, function, and authorship in the circulation of knowledge.

T166-B. The history and philosophy of biology

Fri 26 July, 11:00–12:30 ▪ Roscoe 1.007

Chair: Efthymios NICOLAIDIS | National Hellenic Research Foundation, Greece

Hein VAN DEN BERG | TU Dortmund, Germany

Teleology and biology in eighteenth-century rationalist thought

In the wake of Timothy Lenoir's seminal study of late eighteenth-century German life-science, Kant's teleology has often been interpreted as providing theoretical foundations for the view that biology is a special science. Lenoir's thesis has recently been rejected. Robert Richards and John Zammito have argued that Kant never took biology to be a science. In the present paper, I argue that the interpretative perspective of Lenoir, Richards and Zammito is incomplete. These interpreters reconstruct Kant's teleology in relation to developments in late eighteenth-century biology. I show that in order to fully understand Kant's teleology we must take into account the little known teleological and biological views of Christian Wolff and his rationalist followers. Through establishing the historical importance of Wolffian teleology, we gain novel insight into various important methodological and philosophical debates that surround eighteenth-century German biology. This, in turn, will allow us to give a more balanced account of the relevance of Kant's teleology in the history of biology.

First, I show that Wolff developed an account of teleological inference in the life sciences that was based on an ideal of demonstrative science. For Wolff, propositions specifying the functions of organisms are deductively derived from theological truths. Second, I reconstruct the influence of Wolffian teleology on the philosophical and scientific works of Reimarus and Crusius. I show that they modified Wolffian teleology partly because it was not compatible with theories of (organic) self-organization developed by Buffon, Needham and Trembley. The clash between Wolffian teleology and theories of practicing biologists gave rise to a probabilistic account of teleological hypotheses and a surge of metaphysical debates on the possible vitalist or materialist implications of biology. Third, and finally, I show that the sketched historical context allows us to give a more balanced account of the historical relevance of Kant's teleology. On the one hand, Kant provided a small step in establishing biology as a science by strictly demarcating biology from metaphysical positions. On the other hand, Kant's preoccupation with questions of demarcation led him to adopt a thoroughly anti-realist view on natural purposiveness that was difficult to reconcile with the views and intentions of eighteenth-century practicing life scientists.

Pedro FONSECA | University of Coimbra, Portugal

The history of evolutionary thought in Portugal: the differentiated stances towards evolution of some of Portugal's leading zoologists during the nineteenth and twentieth centuries

The presentation aims at providing a comprehensive view of the differentiated stances of some of Portugal's most prominent zoologists towards evolution during the late 19th century and most of the 20th century. Due to the extension of the presentation, we decided to limit our subject to the leading zoologists that conducted research and lectured at the University of Coimbra. Thus, the zoologists under analysis are: Bernardo Aires (1868-1931), João Gualberto de Barros e Cunha (1865-1950), Francisco Ferrand de Almeida (1931-) and Maria Manuela Assalino (1929-). It is important to notice that the University of Coimbra was Portugal's only university until 1911 and that, in 1865, its Faculty of Philosophy was the stage of the introduction of Darwinism into

Portuguese Science with Júlio Augusto Henriques' (1838-1928) PhD thesis *Are species modifiable?* (1865). First, to guarantee a proper understanding of our subject, we present a brief historical sketch on the history of evolutionary thought and a synthetic exposition on the reception of evolutionary ideas in Portugal during the late 19th century, with special attention to the natural sciences. Second, we introduce some biographical information on the zoologists under analysis. Third, we evaluate the influence of evolutionary theory upon the scientific production each zoologist. Fourth, we carry out a comparative analysis of their differentiated stances towards evolution. In what terms did the zoologists acknowledge the relevance of evolutionary theory to their discipline? To what extent did evolution influence their original scientific research? Did they discuss evolutionary topics in their classes? Were they well informed about the most recent developments of evolutionary biology of their time? Did they address the implications of evolutionary theory upon other fields besides zoology? These are some of the main questions we will seek to provide with answers. In order to provide a wider view of the influence of evolutionary theory upon Portuguese zoologists, the presentation is complemented with a brief reference to the stances towards evolution of other 19th and 20th century prominent Portuguese zoologists working in other institutions besides the University of Coimbra, such as António Machado (1883-1969) from the University of Oporto and Germano da Fonseca Sacarrão (1914-1992) from the University of Lisbon.

This presentation is based on work co-authored by João Rui Pita and Ana Leonor Pereira.

Bo-Chi G. LAI | Department of Bioresources, Da-Yeh University, Taiwan

The origin of Mayr's BSC: the historical perspectives of biological species concept development

Species, the fundamental concept of Biology, is the basic unit for systematic classifying organisms by taxonomists. The species concept is the important implication to approach the phenomena of organisms. Biological species concept (BSC) proposed by Mayr in 1949 has been one of the most popular species concept for several decades. In order to understand the species concept, it will be necessary to realize how biologists apply it, the irreducibility criterion of "a species". In the very beginning, "species" was defined by the differences among biological characters. Referring the meaning of "Species", which is a Latin translation of the Greek word *eidos*, it sometimes translated as "idea" or "form". Plato, Aristotle, and Carl Linnaeus apperceived "species" by essentialism, assuming that everything has its own position in the order, and that the species will never change. So, species as the basic unit of the classification system were defined by the minimum difference among individuals, the most similar individuals clustered as a group and being divided from another group as a species. Furthermore, under the same principle, genus and higher hierarchical classification was settled, and biologists had an ordered relationship to study organisms. However, in the post-Darwinian period, the thinking of "species" has been altered. The BSC suggested reproductive mechanism to identify individuals as species. The reproduction between individuals can describe the entities of spatiotemporally localized relationship in a species and cohesive at any one time. Besides the BSC, there are at least 2 important species concepts widely applied by biologists. The morphological species concept (MSC), established by Carl Linnaeus, the founder of the modern scheme of binomial nomenclature, is still the most practical concept and widely applied in Taxonomy, identified the species by the type specimen. The most popular concept, phylogenetic species concept (PSC), used several traits to be clustered as one or several monophyletic group and each monophyly is defined as the "species". Are they so different that the species concept fell into a long-term debate? How did Mayr's BSC develop in the surging specie concept history river? What is the connection between Mayr's idea and historical development of species concept in Biology? The aim of this article is try to unravel the forming of

Mayr's idea and the historical influences, and to elucidate its perspectives and importance.

T166-C. Philosophy, race, ethnography

Fri 26 July, 14:00–15:30 ▪ Roscoe 1.007

Chair: James MOORE | Open University, United Kingdom

Sadiya QURESHI | University of Birmingham, United Kingdom

'Exterminate all the brutes': dying races and the science of extinction

Lamenting the predicament of dying races became an increasingly prominent occupation in the long nineteenth century. Novelists, painters, scientists, politicians, poets, travel writers and missionaries all contributed to creating and perpetuating the sense that some peoples were doomed to a speedy extinction. For example, in 1847, a reviewer of a London exhibition of San performers observed that the race 'must either become civilised or become extinct'. Arguing that the latter option was 'more probable', he advised Londoners to take advantage of the opportunity to see the increasingly rare specimens. The feelings of imminent change were not unfounded as many human societies found themselves ravaged by the new diseases, loss of land and warfare they suffered due to imperial expansion. Most famously, in 1869 William Lanney, often argued to be the last Tasmanian man, passed away. Just seven years later, Trugernanner, the 'last' Tasmanian woman followed suit. The circumstances leading to this loss sparked and stimulated great discussion over the kinds of political activity that were appropriate for civilised nations, and how best to tackle the fate of the European empires whilst learning from past lessons. Early-modern writers had long noted the apparent decimation of some indigenous peoples; however, such discussions took on a new and urgent form in the nineteenth century as commentators were increasingly able to appeal to a new scientific understanding of extinction as an endemic feature of natural change. For example, in 1871, Charles Darwin's *Descent of Man* naturalised extinction as a feature of intercultural contact arguing that it followed 'chiefly from the competition of tribe with tribe, and race with race.' This paper will explore how scientific discussions of animal extinction were quickly adopted to discuss human population changes within settler colonies and in circumstances many would now see as genocide. In doing so, it will focus on the relationship between scientific knowledge and political policy-making in an imperial context.

Marissa PETROU | University of California, Los Angeles, United States

Crossing oceans and flattening objects: the ethnography of Oceania in imperial Germany

The discipline of ethnology in the late nineteenth century has been characterized as a period of "armchair theorizing," in contrast to the field work methodology which became the distinguishing characteristic of socio-cultural anthropology after the Great War (Conklin, 2002; 260 cf Stocking, 1995). The term obscures the aims and activities of German museum directors who envisioned extensive interaction with collected material culture as the primary means of knowledge collection and production for their discipline. Unlike in Britain and France, many of the larger towns of Germany created major ethnographic museums which competed with the capital for visitors. Directors sought to make their museum a destination site for both tourists and international scholars. The formation of international standards for museum organization, facilities and display technologies was supported by a culture of travel and publication which reviewed collections around the world. For Director A. B. Meyer of the Dresden Museum for Zoology, Anthropology and Ethnology (ZAEM), studying museum collections was just as important as well-qualified, long-term investigations in the field in order to make sense of the material that filled museum galleries and storage

rooms. Meyer trained his museum staff to collaborate extensively with researchers with long term residencies among the ethnic groups under investigation. Furthermore, ZAEM's ethnologists studied how indigenous knowledge, practices and material culture traveled among ethnic groups. The ethnographic questions they asked mirrored their own activities as researchers on expedition. In this way, the practitioners of this new discipline wrote themselves into the history of humankind that they sought after through ethnographic research.

María Haydeé GARCÍA BRAVO | UNAM, Mexico

Les cartes de l'empire: territoire et ethnicité dans la cartographie franco-mexicaine, XIXe siècle

Ce travail est une étude sur les conditions de production des cartes faites parmi les français et les mexicains pendant la période 1860-1880. Il s'agit d'une approche descriptive à la formation de groupes de recherche, leurs discours et pratiques et les instruments associés à cette production. Différents domaines du savoir étaient étroitement liés : la géographie été uni à l'anthropologie, parce que on ne peut pas parler d'un territoire vide, par contre, une partie fondamentale de la problématique étaient les populations originaires, les occupations militaires, l'avance et reculs des troupes, le contrôle de l'espace, l'exercice du pouvoir, la politique et l'administration de tous les types de ressources dans cet espace délimité et en délimitation constante : le Mexique pendant le XIXe siècle. Dans ce processus, les cartes et les chemins de sa construction ont eu l'empreinte des valeurs épistémiques de ce temps là; à travers de la cartographie l'espace souffre une standardisation, il est configuré par les désirs de control territorial. On peut dire que le territoire mexicain a été transformé selon certaines besoins et a été conçu pour répondre aux rêves de l'administration impériale. Et nous ne pouvons pas oublier que tout au long du développement de la cartographie, les instruments de mesure et de calcul ont joué un rôle prépondérant. La carte était réalisée avec des instruments, mais elle devient, après l'étape de production, un instrument elle-même. Nous voulons poser les coordonnées de cette perspective exploratoire, en termes de cartographies sous intervention: d'abord, la coordonnée politique et militaire, c'est-à-dire, l'intervention française elle-même, les combats, l'occupation du territoire, l'imposition d'un autre régime. La deuxième coordonnée c'est l'intervention depuis le point de vue scientifique, l'aller- retour, à travers des voyages transatlantiques, des instruments, des personnes, des cartes, des documents et des instructions et, finalement, la coordonnée d'intervention symbolique, les objectifs cognitifs et politiques des institutions scientifiques et les personnages qui participaient. Nous allons analyser quelques cartes qui ont synthétisée des donnés géographiques, statistiques et ethniques, par exemple, la Carte ethnographique du Mexique de Manuel Orozco y Berra.

T167. Working worlds of the twentieth-century biological sciences

Mon 22 July, 11:00–15:30 ▪ Uni Place 4.206

T167-A. Pure and applied life sciences

Mon 22 July, 11:00–12:30 ▪ Uni Place 4.206

Chair: Alison ADAM | Sheffield Hallam University, United Kingdom

Chittabrata PALIT | RETIRED PROF JADAVPUR UNIVERSITY, KOLKATA, INDIA, India

The scientific thoughts of Girish Chandra Bose on botany

Girish Chandra Bose was a pioneer agronomist of modern India. Botany was a parent subject of agriculture and as such he could also hone his knowledge of botany as his first degree was in Botany. This necessitated writing of a reliable text book of Indian botany. Girish Bose himself undertook the work. The end product was the book, A Manual of Indian Botany and its vernacular version 'Udbhid Gnan'. He reminds us of similar works by Sir J. C. Bose. Bose's constant journey from western theory to Indian specifics is remarkable.

[Submitted entire paper, of which the above is the abstract section -- JS]

Ana BARAHONA | National Autonomous University of Mexico, UNAM, Mexico

Medical genetics in Cold-War Mexico and the circulation of knowledge: human population genetics and cytogenetics in the work of Rubén Lisker and Salvador Armendares

This paper studies the emergence of human population genetics and cytogenetics in the post-war Mexico (1945-1970), emphasizing the global circulation of knowledge, people, and scientific practices, and the institutions involved that enabled the consolidation of human genetics in the country. This paper will focus on the work and contributions of Mexican physicians Rubén Lisker and Salvador Armendares. The study of population genetics was the first branch of human genetics that was developed in Mexico. Lisker graduated from the School of Medicine at the UNAM in 1948. He spent four years (1953-57) at the Michael Reese Hospital of Chicago to pursue research on hematology under Karl Singer. While at Chicago, Lisker met Arno Motulsky, who is considered one of the founders of today's phorico-genomics. Since he returned to Mexico in the late 1950s, Lisker's research laboratory at the Hospital de Enfermedades de la Nutrición focused on the relation between anthropological considerations and medical applications. Following the 1960s trend and technologies he focused on enzymes and other blood components, like the deficiency of the Glucose-6-Phosphate-Dehydrogenase (D6PD) and the presence of abnormal hemoglobins and albumins in Mexican indigenous population. Salvador Armendares graduated from the School of Medicine in 1950 at the UNAM, and specialized in pediatrics at the Children's Hospital of Mexico in 1956. He spent two years as graduate student at the British Medical Research Council in Oxford (1964-65) under the supervision of Dr. Alan Stevenson, who was at the time the dean of the Council and considered one of the first physicians to work on clinical genetics. The first Unit for Research in Human Genetics in the country was launched in 1966 at the Mexican Institute of Social Security upon Armendares' return from England. The unit on human genetics contributed to exploring the effect of severe protein calorie malnutrition on chromosome structure, chromosome aberrations, and the effect of mutagenic agents on chromosomes, and in the late 1970s medical problems with new methods of chromosome banding. Armendares was the first to conduct investigations on Down and Turner Syndromes chromosome characterization, some of which were done with Lisker's collaboration.

Jacques CABARET | INRA, France

The historical evolution of farmers' algorithmic knowledge of diseases in animal husbandry

A farmer's knowledge of animal disease is based on several types of knowledge (Salmona, 1994): algorithmic (learnt in books/journals/school/internet), mimetic (learnt from someone), and phoric (learnt from what you feel). The phoric and mimetic knowledge are intermingled in the metis (Μῆτις= skill or craft) concept (a mixture of wisdom and cunning) of the old Greeks and can be considered as a farmers' adaptive or intuitive means for considering decisions on animal health (Cabaret and Nicourt, 2009). However with increased education and literacy, I expect a shift in farmer's knowledge has occurred, from

being predominantly based on phoric and mimetic knowledge to now primarily utilizing algorithmic knowledge. I will argue that the qualitative examination of literature on diseases can shed light on the evolution of algorithmic knowledge in farmers throughout time.

I used the following documentation intended for farmers as materials for testing my hypothesis: Arabic "Kitab Al-Filaha-أور لكتاب" (Ibn al Awwam, The book of agriculture, end of 12th century in Spain), and several French books "Le parfait bouvier" (Boutrolles, The perfect cattlekeeper, 1797), "Le guide vétérinaire du cultivateur" (Rivière, The veterinary guide for the farmer, 1902), "Le bon moutonnier" (Degois, The good shepherd, 1958) and finally "Les maladies du mouton"(Brugères-Picoux, The sheep diseases, 2004). The Kitab Al-Filaha has a descriptions of diseases (fairly short from the writings of Aristotle or Kastos and thus, algorithmic) and suggested cures which inevitably include a prayer for God's help due to the heavy influence of religion at the time (a phoric base for knowledge). The vagueness of the procedures left much room for subjective interpretation and meant there was a need to learn from someone else (mimetic). To highlight the variation in knowledge types within these books, an example can be found in their recommended treatment of scabies in sheep which ranges from spreading sheep urine with undefined quantities of sulphur on the animal (Kitab), to detailed descriptions of different minerals, their required proportions and frequency of use (Parfait bouvier) to finally advising specific drugs and practices (Guide vétérinaire du cultivateur or Le bon moutonnier).

In the most recent book, only the algorithmic knowledge is present yet we know from interviews that phoric and mimetic knowledge are still used by farmers. The direct analyses of books overestimates the reliance on algorithmic knowledge and the use textual analysis of books could help to correct this bias.

Sophie JOURDIN | Centre François Viète, Université de Nantes, France

Etude des relations entre sciences fondamentales et appliquées dans le cas du laboratoire du phytotron de Gif-sur-Yvette

Créé en 1953 à l'initiative du botaniste français, Pierre Chouard (1903-1983), et fermé en 1986, le laboratoire du phytotron du CNRS de Gif-sur-Yvette est conçu pour devenir le fleuron de la biologie végétale en France. Nous présenterons un bref rappel permettant d'analyser l'intérêt de la création de ce grand équipement novateur dans ce domaine pour la France. Puis, nous étudierons quelques travaux effectués au sein de ce laboratoire, tout comme les applications qui en découlent, notamment dans le domaine de l'agriculture et de l'horticulture, et qui confèrent une reconnaissance internationale au phytotron. L'étude de cas de ce grand laboratoire permettra également de révéler la politique nationale du CNRS comme centre interdisciplinaire associant biologistes, chimistes, physiciens, agronomes et horticulteurs autour d'un objet d'étude commun – le végétal. Nous tenterons ainsi d'analyser le contexte de la production du savoir et la complexité des interactions qui peuvent exister notamment entre chercheurs, disciplines, champs de recherches et institutions. Une comparaison internationale sera entreprise avec son homologue aux USA : le phytotron de Pasadena, premier exemplaire construit dans les années 1940 par le biologiste Néerlandais Frits Warmolt Went (1903-1990).

T167-B. Eugenics

Mon 22 July, 14:00–15:30 ▪ Uni Place 4.206

Chair: Ana BARAHONA | National Autonomous University of Mexico, UNAM, Mexico

Daniele MACUGLIA | The University of Chicago, United States

Corrado Gini and Italian eugenics at work: how Italian racism was used, abused and institutionalized

The debate about whether the development of fascist racism as a state institution was influenced by earlier Italian eugenic research or whether it was formally independent from it is still controversial to this day. Before the First International Eugenic Congress, held in London in 1912, Italian eugenics was not characterized by a clear program of scientific research. With the advent of fascism, however, the equality “number = strength” became the foundation of Italian eugenics. This idea, according to which the improvement of a nation relies on the amplitude of its population, was conceived by statistician Corrado Gini (1884-1965) in 1912. Gini, who was an active part of the fascist regime, had a tremendous influence on Benito Mussolini’s (1883-1945) political campaigns, and shaped Italian social sciences for almost two decades. He was also a committed racist, as documented by a series of indisputable statements from the primary literature. These findings place Gini as a logical connector between early Italian eugenics, fascism, and state racism, highlighting the way in which the deployment of eugenic knowledge was connected to the political and social discourse of the fascist regime.

Cláudia NINHOS | Faculty of Social Sciences and Humanities-UNL, Portugal

The eugenic ‘movement’ in Portugal and the German influence

The eugenic ideas were also debated in Portugal from the 19th Century on and many scientists and academics were involved in an intensive debate, even after the end of the World War II, in magazines, books and scientific meetings.

Portuguese academics perfectly knew what was being discussed in Europe and in the United States. They knew the evolutionary theories, as well as works and authors determinants in this area, especially Lamarck, Darwin, Galton, Gobineau and Chamberlain. The ideas developed in Germany have also infiltrated the thinking of Portuguese scientists. Actually Germany was an important paradigm for many of them. Some of them studied in Germany or simply visited the research centers. German scientists were admired and its institutions were regarded as models to be imported to Portugal. In the thirties was also founded the Portuguese Society of Eugenic Studies. Research “made” in Germany was publicized and propagandized.

This paper will focus on the arguments and proposals presented by Portuguese eugenics advocates. Eusébio Tamagnini, Mendes Correia, Barahona Fernandes or José Aires de Azevedo. They studied the skin color, the nasal index and blood groups, trying to demonstrate the superiority of the Portuguese, defending the inferiority of the indigenous peoples who lived in the colonies.

Sergey SHALIMOV | The St. Petersburg Branch of Institute for the History of Science and Technology Russian Academy of Sciences, Russia

The social history of genetics in the Soviet Union in the second half of the 1960s

The history of genetics in the USSR in the “post-Lysenko” epoch (since 1960s) has been studied much less in comparison with the previous period. The paper is devoted to the second half of 1960s – the time of significant changes not only in the life of the Soviet society, but also in the history of Soviet science. Usually, these years are presented as a time of irreversible, progressive changes and rapid overcoming of Lysenkoism. Evidently, the real situation was more complicated: we can discern opposite trends at this stage. The dismissal of N. Khrushchev (1964) created more favorable conditions for the development of genetics in comparison to the previous period. At the same time the reorganization of the Soviet biology after his leave developed in a complex and contradictory way. Besides intrascientific factors there were

some negative socio-political imperatives. Two of them played the most significant role. First of all, the opposition of “lysenkoites” continued. The second factor is characterized by changing politico-ideological atmosphere and by the rise of conservative and neo-Stalinism trends in the Soviet policy. Lysenko’s associates, who hold high positions in science and education, played an active role in the increasingly visible “conservative turn”. Thus, the development of Soviet genetics in the second half of 1960s is characterized by controversial trends. The most important feature of these years was changing social and political context of the development of genetics. In the new conditions genetics became considered as a legitimate field of research and even got some government’s support. Nevertheless, the support extended by the Soviet authorities was inconsistent and of a rather declarative character. For example, there was no official statement, in which T. Lysenko and his activities were negatively evaluated. Moreover, in course of time the opportunities for criticism of T. Lysenko were considerably narrowed. Research in certain areas, including human genetics that was rapidly developing worldwide, was limited by rigid ideological frameworks. These negative trends intensified in the course of time with the “conservative turn” in socio-political environment that occurred in the second half of the 1960s. Acknowledgments: The research project has been supported by the Russian Foundation for Humanities, grant no. 12-33-01295.

Pedro Felipe NEVES DE MUÑOZ | Fundação Oswaldo Cruz (FIOCRUZ), Brazil

Neuropatologia e Eugenia nas relações médicas entre Brasil e Alemanha (1919-1945)

O presente trabalho faz parte de uma pesquisa de doutorado sobre a medicina mental nas relações científicas de Brasil-Alemanha (1919-1945). O estabelecimento das relações entre a medicina mental brasileira e alemã, data da virada do século XIX para o XX, sob a agenda de trabalho do Dr. Juliano Moreira (1873-1933), diretor do Hospício Nacional de Alienados (1903-1930), no Rio de Janeiro, capital federal do Brasil. A partir de uma bolsa de estudos para a Europa, Moreira conheceu Emil Kraepelin (1856-1933) e sua Escola em Munique. Desde então, Moreira retornara diversas vezes a Alemanha, estabelecendo um estreito vínculo dos com médicos alemães. Junto com Afrânio Peixoto (1876-1947), Ulysses Vianna, Antônio Austregésilo (1876-1960) e outros, Moreira liderou um projeto de re-apropriação e difusão, no Brasil, da medicina mental alemã, principalmente, a kraepeliana. Após a Primeira Guerra Mundial (1914-1918) e o Tratado de Versalhes (1919), a Alemanha se aproximou da América Latina como uma estratégia econômica e de divulgação científica. Assim, a partir dos anos 1920, organizou-se uma intensa rede de trocas científicas entre médicos brasileiros e alemães, a partir da qual circulavam conhecimentos e pesquisas que buscavam abordar as doenças mentais e nervosas como fenômenos orgânicos e cientificamente explicáveis. Em igual medida, eram frequentes os debates sobre os problemas nacionais e sociais da raça, da degeneração e da hereditariedade que exigiriam medidas profiláticas e eugênicas. Dessa forma, o escopo desta apresentação é analisar a circulação de médicos, pesquisas científicas e conhecimentos sobre a neuropatologia e eugenia, entre os médicos do Rio de Janeiro, Munique e Hamburgo, no período de 1919 e 1933. Com esse intuito, empreenderemos uma história intelectual e transnacional da medicina, a partir da qual investigaremos a rede teuto-brasileira da medicina mental. Para tanto, analisaremos um corpus documental composto por congressos nacionais, latino-americanos e internacionais; viagens científicas; cursos de médicos; correspondências; mas, principalmente, periódicos especializados em psiquiatria, neurologia e eugenia, de veiculação nacional e internacional (Arquivos Brasileiros de Neuropsiquiatria e Psiquiatria; Arquivos Brasileiros da Liga Brasileira de Higiene Mental; Revista Médica de Hamburgo e Revista Germano-Ibero-Americana; Zeitschrift für die Gesamte Neurologie und Psychiatrie; Deutsche Zeitschrift für Nervenheilkunde).

Neuropathology and eugenics under the Brazilian and German medical relationship, 1919-1945

This work is part of a PhD research and it is about the mental medicine in the scientific relationship between Brazil and Germany (1919-1945). The establishment of the Brazilian and German mental medicine relationship occurred in the end of 19th century and the beginning of 20th century, through the Dr. Juliano Moreira's (1873-1933) agenda, as director of the National Asylum (1903-1930), in Rio de Janeiro, Brazilian's federal capital. With one scholarship to study in Europe, Moreira met Emil Kraepelin (1856-1933) and his psychiatry school in Munich. Since then, Moreira had returned several times to Germany, establishing a close link with German doctors. In partnership with physicians Afrânio Peixoto (1876-1947), Ulysses Vianna, Antônio Austregésilo (1876-1960) and others, Moreira led a project of re-appropriation and diffusion of German mental medicine, in Brazil, mainly the Kraepelin's ideas. After the First World War (1914-1918) and a despite of the Treaty of Versailles (1919), Germany became closer to Latin America, as economic and as scientific strategy. Thus, in the 1920's, the Brazilian and German medicine network became more intensive, with the circulation of physicians, knowledge and practices. Those physicians aim to scientifically explain the mental and nervous diseases as organic phenomenon. Therefore we can find strong debates about national and social issues of race, heredity and degeneration which would require prophylactic and eugenic measures. In this way, the scope of this presentation is to analyze the circulation of scientific research and expertise on neuropathology and eugenics, among Rio de Janeiro's, Munich's and Hamburg's physicians, since 1919 to 1933. As transnational and intellectual history of medicine, we will investigate the movement of physicians, knowledge and practices in the German-Brazilian network of mental medicine. To do that, we will investigate an extensive sources: National, Latin American and international Congress; scientific voyages; medical courses; letters; but, mainly, journals in Psychiatry, Neurology and eugenics (Arquivos Brasileiros de Neuropsiquiatria e Psiquiatria; Arquivos Brasileiros da Liga Brasileira de Higiene Mental; Revista Médica de Hamburgo e Revista Germano-Ibero-Americana; Zeitschrift für die Gesamte Neurologie und Psychiatrie; Deutsche Zeitschrift für Nervenheilkunde).

T170. Medicine and colonialism

Fri 26 July, 09:00–10:30 ▪ Uni Place 4.204

Chair: Ruth BARTON | University of Auckland, New Zealand

Anna GREENWOOD | University of Nottingham Ningbo, China

Harshad TOPIWALA | Independent Scholar, United Kingdom

Inappropriate conduits of medical knowledge: why Indian doctors were excluded from the Colonial Medical Service in Kenya

Indian doctors were for some time regarded as appropriate mediums for the dissemination of western medical knowledge in East Africa, despite the fact that their contribution has largely been forgotten by historians. Although Indian practitioners were not appointed to the same rank as European Medical Officers (MOs), they nevertheless were medically qualified individuals, who had undergone training in western medicine in India, usually for a minimum of three to five years depending upon when and where their diploma or certificate was obtained. Despite being awarded the less-prestigious rank of Assistant Surgeon, Sub-Assistant

Surgeon or Hospital Assistant within the CMS, and being paid much lower salaries than MOs, these Indians to all intents and purposes fulfilled similar clinical roles and responsibilities to their European counterparts. Indeed, ample evidence exists that, before 1923, Indian practitioners were regarded as an invaluable constituent part of the medical infrastructure. At their peak in 1920, there were almost twice as many Indian medical practitioners as European MOs in the Government Medical Department. After 1922, however, the recruitment of Indians to the CMS halted.

Through original research conducted at the British Library, The Wellcome Library, Syracuse University Library, The British Medical Association Archive, and The Kenya National Archive, this paper will highlight how this Indian cohort of medical personnel have been overlooked by historians for decades and describes some of the dynamics behind the production of colonial knowledge, both at the time and subsequently.

It will be argued that the British progressively excluded Indians from working in the CMS in Kenya because the practice became increasingly antithetical to the new priorities of Empire. As ideas of trusteeship became fashionable from the 1920s, it became ever more appropriate to Africanise the CMS, in terms of training and employing more African doctors. However, at the same time (and with no apparent sense of contradiction) as the Service became more inclusive to Africans, it became less inclusive to Indians. This implies that, despite British rhetoric, something more complicated than progressive racial inclusionism was going on. In key ways, Indians working in roles similar to Europeans in Africa posed a threat to British ideas of colonial hegemony and their role as a practical means of disseminating colonial medical knowledge became no longer acceptable to the priorities of settler dominated Kenya.

Markku HOKKANEN | University of Jyväskylä, Finland

Success and failure in colonial knowledge-making: Central African medicines and poisons in the British Empire, ca. 1859-1930.

Recent research has highlighted the importance of knowledge for imperial and colonial projects, the significance of networks in the production of scientific knowledge, and the importance of medicine for colonial history in the modern era.

This paper brings together these major strands of research by focusing on British attempts to identify, understand, and benefit from African indigenous medicines and poisons in Central Africa. In particular, the paper discusses a 'successful' case of colonial knowledge-production (the 'discovery' of the *strophanthus kombe* arrow poison plant and the subsequent development of cardiac drug strophanthin) alongside less successful attempts of colonial doctors, officials, and missionaries to study African medicines and poisons.

It is argued that in colonial medical encounters (in which both sides mocked and were curious about each other), African medicines remained more of a secret to Europeans than vice versa, and that key reasons for this can be identified through the careful micro-level study of colonial knowledge-production. The paper emphasises the crucial importance of various mediating 'middle figures' (African and European) in colonial and imperial networks, without whom colonial knowledge connected to local medicinal practices and substances could not have developed.

The proposed paper is based on research conducted in Britain and Malawi, and draws upon my previous work as well as a current book project about the cultural history of colonial medicine.

Jane Sung Hae KIM | UCLA, United States

Globalizing colonial medicine: leprosy and international health in interwar Korea, 1926-1931

This paper examines the role of League of Nations Health Organization in shaping leprosy control in colonial Korea and East Asia. In 1931, the Japanese colonial government in Korea announced the formation of Chosen Leprosy Prevention Association. Shortly after the colonial government made the announcement, the Government of Japan revised the 1907 segregation law and the establishment of leprosy prevention association. Called Japan Leprosy Prevention Association, the association had been modeled after the British Empire Leprosy Relief Association (BELRA). With colonial Korea and Japan proper passing legislation, in Taiwan, the Japanese colonial government made the announcement of government leprosarium in 1933. To scholars working on East Asian history of leprosy, the year 1931 was the pivotal moment when compulsory leprosy began in the empire. This paper proposes new reading of the 1931 leprosy activities in East Asia by exploring the involvement of Kiyoshi Shiga, the discoverer of dysentery bacillus, in the Leprosy Commission of the League of Nations Health Organization from 1926 to 1931. At the time, the dean of faculty of medicine at the Keijo Imperial University, the colonial university in Korea, Shiga was asked by Ludwik Rajchman, the head of LNHO in 1926, to join the newly established expert committee on global leprosy eradication control. The LNHO activities in those years resulted in the first world survey of leprosy and principles on prophylaxis of leprosy, one of very first attempts to standardize leprosy treatment in 1931. By studying Shiga's involvement in the Leprosy Commission, the argument of this paper is that East Asian history of leprosy, in particular, the year of 1931 has to be reconsidered in the context of the international health movements that were taking place in the interwar years (1919 ~ 1941) around the world. By showing the connection between Shiga's activities in colonial Korea to the League of Nations, ultimately, the conclusion here is that modern health and medicine in Korea, Taiwan and Japan cannot be simply understood as legacy of Japanese colonialism, but as result of exchanges and interactions with actors, agencies and movements within the larger international health and medical activities of the interwar years.

T171. Medical authority boundaries and medical knowledge

Sat 27 July, 09:10–17:40 ▪ Uni Place 4.205

T171-A. Eighteenth- and nineteenth-century medicine

Sat 27 July, 09:10–10:40 ▪ Uni Place 4.205

Chair: Simon WERRETT | University College London, United Kingdom

Katherine FOXHALL | King's College London, United Kingdom

Nineteenth-century men of science and the making of 'authentic' migraine aura

During the 1860s a group of well-known British 'men of science' - including David Brewster (astronomer and inventor of the kaleidoscope), George Biddell Airy (astronomer) and John Herschel (astronomer and photographer) - corresponded in scientific journals about the temporary visual disturbances that they had experienced. They accompanied their discussions with intricate diagrams of how pulsating spots, arcs, zigzags and blindspots of a disorder known as 'scintillating scotoma' obscured and moved across part or all of the visual field.

These men understood their auras not as disease *per se*, but as a natural extension and confirmation of their scientific endeavours and

persona, informing ongoing debates about vision, sight and scientific objectivity. Their accounts are conspicuously devoid of admissions of pain, weakness, or distraction. Moreover, they did not use the term migraine. This paper will examine how, by the 1890s, these images gained the status of scientific 'truth', and came to define a new understanding of migraine that had become acceptable, in no small part, because of the authority of these men of science. Confirmed as beautiful, accurate and most importantly 'trustworthy' by Sir William Gowers, these images have become foundational documents for modern understandings of migraine.

For over a century now, other sufferers' depictions of migraine experience - particularly self-portraits, or artworks that represent pain - have been tested against these 'scientific' images, and either accepted as authentically migrainous, or rejected as useless, their reliability compromised by impaired concentration and disturbed cognition. By examining the creation of a very particular kind of medical knowledge, and the subsequent work that has been done on behalf of this knowledge, this paper challenges an extant history of migraine. In addition, I will suggest that the history of these images raises important questions about the relationship between medical imagery and art, and the status of 'illustration' versus 'evidence'.

Mauricio SANCHEZ MENCHERO | UNAM, Mexico
Teresa ORDORIKI | UNAM, Mexico

Women and chocolate: representations of female hysteria during the eighteenth century

Like many of his colleagues, New Spain's physician José Ignacio Bartolache published articles on contemporary topics that were of interest for European readers, one such topic had to do with the disease of hysterics that plagued women in the 18th century. According to him and other experts, one of the causes of that particular malady was the consumption of chocolate. By the 18th century the production and consumption of this American beverage had extended throughout the Western world. Its popularity had led to the increase of land for its cultivation, the creation of new culinary recipes and even the manufacture of utensils specially designed for its preparation and consumption. People from all walks of life sang its praises, it qualities were researched by scientists, particularly chemists, and artists pictured it in their works. However, because chocolate came from a land regarded as exotic, it was easily linked, through symbolic attributions, to diseases such as hysteria. Academic treatises dealing with "diseases of the soul" stated that women's ailments were the result, among other things, of the consumption of this American drink, a notion lasted up to the end of the XIX century. Although opinions such as Mexican thinkers such José Antonio Alzate disputed the idea that hysteria was an exclusively a female malady, this view would remain until the emergence of disciplines such as neurology (Jean-Marie Charcot) and psychology (Sigmund Freud). The link between chocolate and female diseases allows us to raise questions about the Atlantic circulation of academic knowledge as well as natural and manufactured goods: What medical discourses relating the consumption of this beverage to hysteria were established and used by Americans and Europeans? To what extent were they similar? How did "scientific" knowledge influence the production and consumption of chocolate? How did physicians and academics of both sides of the Atlantic participate in the debates about the benefits or evils of this product? Finally, it also raises questions about the cultural specificities given to women diagnosed with this disease and how these related to differences pertaining to race, religion and geography.

John STEWART | University of Oklahoma, United States

Chemical affinity, mineral waters and medical authority in the Scottish Enlightenment

First at the University of Glasgow and then at Edinburgh, William Cullen and his students used chemical affinity to analyze mineral waters in their courses on materia medica, chemistry, and later natural history. These

chemical analyses provided information about the constituency, medical efficacy, and the natural and artificial formation of spa waters. In turn, the precision required in isolating dilute salts in mineral waters drove the advancement of affinity theory and its analytical techniques. The recognition that gases and various non-soluble earths contributed to the medical efficacy of mineral waters but could not be studied in samples that had been bottled and shipped led to the rapid development of in situ experimentation. Mineral water literature was a medium of advertising, for the water as a natural commodity, the spa as a medical resort, and the doctor as an authority. Doctors wrote pamphlets, articles, and monographs to gain the patronage of the gentry who owned or controlled the spas and to attract clients. In a period with no formal system of medical accreditation, these publications served as credentials demonstrating formal education, knowledge of a particular spa, and (through the dedication and list of subscribers) the patronage of the local gentry. I use the correspondence and mineralogical publications of Cullen and his students to show how affinity chemistry superseded the battery of tests that had been used in the sixteenth and seventeenth centuries to identify the constituents of mineral waters. I will also detail how these doctors sought and gained patronage through their various publications.

Alexander WRAGGE-MORLEY | University of Oxford, United Kingdom

Medical knowledge, connoisseurship and virtue in Britain, 1700-1750

In this paper I show how and why physicians and surgeons in eighteenth century Britain came to be seen, and to see themselves, as especially qualified to act as connoisseurs of art objects, antiquities, books and prints. Although several historians of art and science have shown that eighteenth century medics were much-involved in the world of connoisseurship, the roots and broader explanatory potential of this connection remain largely unexplored. To remedy this I explore the possibility that their medical knowledge was inflected by contemporary concerns about the effects of valuable, expensive things on the bodily and moral integrity of those who bought and used them. The paper tackles these broader issues by offering a reassessment of the cultural and medical interests of powerful and influential London physicians and surgeons such as Richard Mead (1673-1754), George Cheyne (1671-2-1743) and William Cheselden (1688-1752). I focus on the works produced in their circle that expose the conceptual and practical links between ideals of medical behaviour and expertise, and those of connoisseurship - including works of art theory, such as Jonathan Richardson's essay on connoisseurship and pamphlet debates engaged in by the followers and opponents of Richard Mead. Although ostensibly concerned with questions of medical authority, matters of taste and connoisseurship were often invoked in order to attack or defend the medical authority of physicians and surgeons. The broad purpose of this paper is to show how the medical knowledge made by physicians and surgeons such as Mead and Cheselden was inflected by a number of discourses that seem (to modern eyes) to lie outside the proper field of medicine. Mead and his contemporaries invoked claims to good taste in art, antiquities and books in support of their medical authority because they saw the two activities as having much in common. Medics came to be seen as good judges of taste because of their special capacity to help mediate between the body, its senses and the things around it, including luxury food and luxury 'things' - both of which were equally capable of disordering the body and mind. These connections between ideas about the body and the consumption of material things can help us to reconsider the history of eighteenth century natural philosophy - a set of practices that relied explicitly on successfully using the body to derive useful inferences from a wide range of things outside and inside it.

T171-B. Medical boundaries and disputes

Sat 27 July, 11:10–12:40 • Uni Place 4.205

Chair: Christopher HAMLIN | University of Notre Dame, United States

Tim CARTER | University of Bergen, Norway, United Kingdom

Port Red, Starboard Green: contested testing of seafarer colour vision, 1880-1914

The introduction of red and green navigation lights for ships resulted in a number of collisions that were attributed to colour vision impairment. The UK Marine Department introduced screening tests for colour vision in the 1880s but when these were found to have limitations, the evidence on risk was reviewed and an adviser, Edridge Green with expertise in physiology, was engaged. Before his work was completed the Royal Society offered to recommend improved test methods. The Holmgren wool method was proposed by Abney, their leading expert and a pioneer of colour photography. It was used for the next 20 years but there was increasing evidence of poor validity and reproducibility. This led to a test case supported by one of the marine officer's professional associations' which was the subject of parliamentary questions involving Lloyd George and Churchill. The case was resolved by a trial nighttime voyage along the Thames and the Royal Society's advice became no longer sustainable when, despite failing the tests they supported practical colour discrimination was found to be perfect. This led to acrimony, to a scientifically well founded set of practical studies of distant night colour vision funded by the Marine Department and to the the introduction of a new form of testing using a lantern with coloured lights, an approach that remains standard up to the present day. Edridge Green pioneered this test but, despite the evidence, Abney and the Royal Society found it hard to accept the faulting of their position by good science and an early rival. This study exemplifies of the problems in the application of knowledge based on theoretical principles to a pressing practical problem. It also demonstrates the interactions between the scientific community, the political world and the emerging voice of employees in the early twentieth century. Finally the status, personal values and motivations of those offering expertise played a key part.

Ignacio SUAY-MATALLANA | University of Valencia, Spain

Water analysis in the nineteenth century: a disputed knowledge across the borders from chemistry to medicine

This paper will study how water analysis was a disputed knowledge in the 19th century. The study of scientific controversies and the role of experts related to analysis of water has a great interest in the study of 19th century science, its protagonists and its practices. Controversies related to the analysis of baths and spas were very frequent. Spas were a place across the borders from chemistry to medicine where distinct techniques, diverse interests and different traditions were discussed. Water analysis was not only a complex chemical operation but also one of the most controversial. This operation involved pharmacists, physicians, chemists and engineers who employed distinct techniques, pursued diverse interests and assumed different traditions. By analysing the water of the spa experts claimed the medical efficacy and the chemical composition of the bath.

This paper will study the wide range of interests related with baths and spas and some of the disputes between experts for controlling their analysis. The importance of some chemical elements dissolved in the water, the medical effects of taking a bath into the spa instead of employing bottled water, or the differences between natural and artificial water are an example of these controversies. Finally, we will study the development of chemical analysis in Spain focusing on the contribution of Antonio Casares (1812-1888). He was a prominent Spanish chemist who wrote several chemistry treatises and analysed some of the most important Spanish spas. By comparing some of his works we will study how the analysis not only involved disciplinary interests, but also economic and even personal ones.

Mar CUENCA-LORENTE | Lopez Piñero Institute for the History of Medicine and Science (CSIC University of Valencia), Spain

~~WITHDRAWN: Where are the experts? Solving poisoning cases in nineteenth-century Spain~~

Allister DIAS | Fundação Oswaldo Cruz, Brazil

Arquivos de ciência, crime e loucura: “irresponsabilidade penal” e “periculosidade” no debate médico-jurídico brasileiro da década de 1930

As discussões sobre a natureza do homem criminoso no Brasil começam a se adensar de forma mais significativa em fins do século XIX e início do século XX, com a tomada de posições de médicos e juristas perante os debates internacionais vigentes no período, e, sobretudo, em deliberações sobre casos concretos nos quais a questão da possível anormalidade de delinquentes foi colocada, implicando a ingerência do saber médico-antropológico no âmbito da justiça penal.

Esta apresentação abordará dois temas centrais no debate médico-jurídico no Brasil deste contexto, como ênfase na década de 1930: a “periculosidade” e a “irresponsabilidade penal” de certos criminosos. Os debates sobre estes temas serão acompanhados em três relevantes espaços de discussões criminológicas do período: o Conselho Penitenciário do Rio de Janeiro, o Manicômio Judiciário do Rio de Janeiro e a Sociedade Brasileira de Criminologia. Em tais instituições são debatidos os destinos legais e institucionais de vários criminosos, bem como suas naturezas antropológicas e morais. Configuram-se, assim, discursos e posições muito claras por parte de médicos e juristas do período. A dicotomia estrita médico-jurista não faz sentido aqui, na medida em que ora psiquiatras discordam entre si, ora psiquiatras e juristas concordam e se aliam na defesa de certos argumentos, ora juristas se opõem, entre outras configurações possíveis.

No que diz respeito à questão da irresponsabilidade penal, vários médicos e juristas passavam a defender a perspectiva da “responsabilidade atenuada” em casos de crimes por motivos passionais (a maioria com subsequente tentativa de suicídio), por paroxismo epilético ou mesmo em virtude da carga hereditária degenerada, reveladas em constituições psíquicas e orgânicas anômalas, de certos criminosos. A possibilidade de um indivíduo ser “parcialmente responsável” por seus atos não estava prevista na legislação penal brasileira do período, e era componente essencial em certos discursos. Nesse âmbito, algumas perspectivas psiquiátrico-antropológicas eram questionadas por focar unicamente fatores individuais, desconsiderando os interesses coletivos. Já a questão da periculosidade constituía-se num grande denominador comum, orientando decisões judiciais. No entanto, era motivo de polêmica quando se atrelava a outras discussões, como a questão da regeneração dos delinquentes e a eficácia terapêutica do sistema prisional.

Archives of science, crime and insanity: ‘criminal irresponsibility’ and ‘dangerousness’ in the medical-legal debate in 1930s Brazil

The discussions about the nature of the criminal man in Brazil begin to thicken more significantly in the late nineteenth and early twentieth century, with the positions taken by doctors and lawyers about the current international debates in the period, and especially in deliberations on specific cases in which the issue of the possible abnormality of offenders was placed, implying the interference of the medical-anthropological knowledge within the criminal justice.

This presentation will address two central issues in the medico-legal debate in Brazil, emphasising the 1930s: the “dangerousness” and the “criminal irresponsibility” of certain

criminals. The discussions about these topics will be analyzed in three relevant areas of criminological discussions of the period: the Penitentiary Council of Rio de Janeiro, the Forensic Hospital of Rio de Janeiro and the Brazilian Society of Criminology. In such institutions are discussed the legal and institutional destinations of various criminals and their anthropological and moral natures. Then, the speeches and positions of the physicians and jurists of the period became very clear. The strict dichotomy between doctors and lawyers does not make sense here, since psychiatrists sometimes disagreed, while in some situations psychiatrists and jurists agreed and got together in defense of certain arguments, among other settings.

Regarding the issue of criminal irresponsibility, several doctors and lawyers began defending the prospect of “attenuated responsibility” in cases of crime of passion (most with subsequent attempted of suicide), epileptic paroxysm or even due to degenerated heredity, revealed by anomalous organic and psychic constitution of certain criminals. The possibility of an individual being “partly responsible” for his actions was not foreseen in the Brazilian penal legislation of the period, and was an essential component in certain opinions. In this context, some psychiatric-anthropological perspectives were questioned for focusing only individual factors, disregarding collective interests. Nevertheless, the issue of “dangerousness” was a great common denominator, guiding judgments. However, it was a source of controversy when it had to deal with other discussions, such as the issue of regeneration of offenders and therapeutic efficacy of the prison system.

T171-C. Medical boundaries of authority and expertise

Sat 27 July, 14:10–15:40 • Uni Place 4.205

Chair: Victoria BATES | University of Exeter, United Kingdom

Gweneth CROSS | Wilfrid Laurier University, Canada

‘Authorised by the Central Midwives Board’: obstetrical advancements and the autonomy of midwifery in England and Wales, 1902-1948

In 1902 the Midwives Act for England and Wales established certified midwifery as an official part of the medical profession. Women were initially allowed to work as midwives if they had either completed training or proven to the board that they had practiced for a minimum of one year prior to the passing of the Act and were of “good character.” Changes to the Act, culminating in the 1936 Midwives Act, saw such provisions for existing midwives removed, and only women who had completed the training and examination as set out by the Central Midwives Board were permitted to work as midwives in England and Wales. The changes to the Act brought in restrictions as to who could work as a midwife, but also granted greater medical autonomy to midwives. Such medical autonomy was recognised through increased freedom to administer medications—although the administering of drugs was still highly regulated—and the potential for training in gas and air analgesia. The changes to the Midwives Act and the training of midwives changed midwifery and gave more parturient women access to medicalized care. This paper addresses how professional hierarchies influenced the practice of midwifery in England and Wales and argues that, throughout the first half of the twentieth century, the influence of these professional hierarchies lessened as midwifery became a relatively autonomous branch of the medical profession. This paper focuses especially on advancements in obstetrical science and technology to consider how midwives both used and influenced these advancements. Looking at the

regulation of midwives and the associated disciplinary hearings reveals a change in emphasis throughout the first half of the twentieth century: by the latter half of this period such hearings were predominantly about the midwife's medical technique rather than her character or hygiene. Studying the correlation between medical advancements and the associated professional hierarchies shows that, while the regulation of midwifery became more rigorous throughout the twentieth century, midwifery also became an integral branch of the medical profession.

Sabine ARNAUD | Max-Planck-Institute for the History of Science, Germany

Boundaries of expertise and boundaries of responsibility in the care of deaf pupils in nineteenth-century France

Throughout the nineteenth century in France, the National Institution for Deaf-Mutes belonged to the Ministry of Interior. This dependence defined the education of the deaf-mute (this was the term current at the time) as welfare—in contradistinction to other schools, which were the domain of the Ministry of Education. The division was regularly attacked, and led teachers and educators to question the authority accorded to doctors in working with the deaf. They complained that the distinction resulted in a lack of coordination in teaching techniques, and argued that a dedicated *Ecole normale* should be created to train teachers of the deaf-mute. These debates took on enough importance to be discussed in the definition of deaf-muteness in the 1883 volume of Jaccoud's *Nouveau dictionnaire de médecine, de chirurgie*.

This paper will address the encounter between political, pedagogical, and medical claims for competence in the teaching of deaf-mute pupils. In the course of their attempted appropriations, politicians such as Watteville and Esquiros, educators such as Puybonnieux and Rancurel, and doctors such as Jaccoud and Bourneville tried to delimit the capacities of the deaf and determine their status in society. But in defining the deaf, these authors were shaping the role of their own discipline. Through a selection of the arguments made for moving responsibility for the National Institution to the Ministry of Education, I will investigate the struggles between the disciplines concerned and the role of those struggles in shaping both their writing and their positioning toward each other. I will examine how the authors quoted seek to assert the boundaries of their field of expertise just as much as their own knowledge: it was acknowledgment of this expertise that would guarantee them access to their object of study.

Ju-Yi CHOU | UCL, United Kingdom

Science, social identity and boundary: reforming towards a scientific medicine at the London School of Homoeopathy, 1875-1883

This paper provides a new perspective on controversies between orthodox and unorthodox medicine. While most researches focused on the interactions between the two sides, this paper examines the perspectives of the practitioners of unorthodox medicine combining the theoretical framework of the Social Identity Theory (SIT) in social psychology and Gieryn's Boundary Work. This paper argues that the idea of science and internal conflicts between group members played significant parts on how practitioners of unorthodox medicine define their relationship with orthodox medicine and their own practice.

Homoeopathy was an important unorthodox medicine flourished throughout the nineteenth century and declined at the end of the century in Britain. Previous researches interpret the decline as a consequence either of the triumph of biomedicine, or the competition over clients with orthodox practitioners, or the process of professionalisation. Most researches see homoeopathy as a homogeneous group and define the practice anachronically.

The historical case under analysis is how a particular group of homoeopaths, the professionally qualified British homoeopaths, used the rhetoric of science to justify and adapt their social identity in relation to

other medical practitioners, including both homoeopaths and non-homoeopaths, during the reform of the London School of Homoeopathy. This was done to meet the challenges they believed homoeopathy was going through within and without between 1875 and 1883. There were three main concerns: to whom homoeopathy should be taught, the curriculum, and whether a separate license should be obtained for homoeopathy. The School was established as a blend of different opinions and had very few students in the end. Many professional British homoeopathy considered it irrelevant since what they pursued a scientific medicine and hence a separate existence of homoeopathic education was unnecessary.

This paper concludes that the distinctions between orthodox and unorthodox medicine as devised by later historians do not fit into professional British homoeopaths' social identity. The homoeopaths reckoned that the "decline" of homoeopathy was a natural progression of scientific medicine since they believed in practising "scientifically," rather than "homoeopathically."

The primary sources are journals and articles published by professional British homoeopaths to state their beliefs either to other homoeopaths or to the lay public.

T171-D. Knowledge-making in modern medicine

Sat 27 July, 16:10–17:40 • Uni Place 4.205

Chair: Katherine FOXHALL | King's College London, United Kingdom

Bernardo OLIVEIRA | Universidade Federal de Minas Gerais, Brazil

Medicine textbooks and their role in the dissemination and maintenance of practices: the case of episiotomy

This paper seeks to deepen the understanding of textbooks' role in the history of the dissemination of scientific practices. The dogmatic and outdated character of science textbooks has been highlighted as fundamental in the formation of styles of thought (Fleck) and in the inculcation of paradigms (Kuhn) in the new generation of scientists and experts. However, this characterization has been reappraised. Historical analyses of some manuals reveal that some of them were not just updated but also innovative (Kaiser, 2004; Bensaude-Vincent, Sánchez & Belmar, 2004). On the other hand, historians of education (Olesko, 1991; Belhoste, 1995; Gispert, 1991) show how science teaching, much more than being mere derivations of science or conservative simplifications, constantly takes part in the process of reshaping scientific research. In this paper we focus on obstetrics textbooks – more specifically, on the approach of the controversial technique of episiotomy (a vaginal incision proposed to facilitate childbirth), which was disseminated in the 1920s and since 1983 has been contested by scientific evidence. Influenced by this research, the World Health Organization (WHO) recommends, since 1985, the restriction of this technique to special cases. However, it is the hegemonic practice in many countries – and the maintenance of this tradition is based on the education of young doctors. The controversy concerning episiotomy makes this practice an interesting case to understand the role of education and textbooks in the dissemination of knowledge and practices. We analyzed three of the main textbooks of wide circulation in Brazil during the last four decades: Rezende's *Obstetrics* (Rezende, Rezende Filho & Montenegro), Rezende's *Fundamental Obstetrics* (Rezende, Montenegro & Barbosa), and Williams' *Obstetrics* (Williams, Pritchard, MacDonald & Gant). These publications were selected based on their editorial success, shown by their several editions and their use as bibliographical reference in major medical schools in the country. The verification of the practically unaltered approach of the episiotomy in these books led us to discuss

the reasons of this persistence. Thus, at the end of this paper, we discuss give explanatory hypotheses about the teachers' motivations for adopting these manuals and reinforcing this practice.

This presentation is based on work co-authored by Maria Lansky.

Sally FRAMPTON | University College London, United Kingdom

Disbelief and nostalgia: working to create the past in nineteenth-century surgery

Surgeons of the late nineteenth-century were fascinated by the process of knowledge-making that had occurred in their field over the previous half-century. Developments in antiseptics and laboratory science as well as radical changes in operative techniques contributed towards a collective identity where surgeons imagined themselves as both history-in-the-making and the future. With the opportunities afforded by the turn of the century for reflective thinking, this period saw a substantial project among surgeons to historicize their recent work through lectures and publications which were notable for emphasising a circularity between medical culture, biography and history. "Can we to-day believe" commented the physician Lionel Weatherly in 1898 in reference to one of surgery's most important innovations, ovariectomy, "that it was only a comparatively short time ago that the benches of the Royal Medical And Chirurgical Society rang with excited cries of 'Down with the Belly-Rippers!'" Weatherly's comments suggest how surgeons put contemporary knowledge to work – in this case knowledge of ovariectomy's progressive path to acceptance - to make incomprehensible what had come before. Nonetheless far from constructing only simplistic, positivist accounts, such sentiments were often countered by an apprehension as to where the future of surgery lay and a desire on the part of many surgeons to look back at the past decades both nostalgically and for guidance on the future. Was it possible for there to be *too* much surgical knowledge? And if this was the case, was it detrimentally affecting surgical practice?

While Victorian scholars in other fields have begun to re-assess the late nineteenth-century as a crucial period in historiography, in the history of medicine it generally remains dismissed as a time of celebratory accounts of doctors' triumphs and thus of little intellectual value (calling into question the continued separateness of 'history' from the 'history of medicine'.) In particular Victorian histories of surgery tend to be viewed as the gloating of triumphalist surgeons. This paper argues for a re-evaluation of that period. Rather than assuming the history of surgery at this time to be a whiggish pursuit entirely separate from academic historians' intellectual agenda, I instead show how the surgical profession tried to make sense of the numerous recent innovations that had occurred in their field. For surgeons, ever caught between theory and performance, historicization presented much needed clarification and perhaps even a surgical philosophy.

Constance PUTNAM | Independent Scholar, United States

Knowledge-making in a rural general practice in mid twentieth-century America

A strong tradition of rural general practice exists in the United States. Given the remoteness of the areas where solo practitioners often worked, the need for doctors to use everything they knew was considerable. Especially for a newly minted M.D., critical skills included improvising and using every available resource.

Even in the middle of the twentieth century, many rural doctors in the United States had offices in their homes and routinely made house calls. The typical image that comes to mind is a romantic one of male practitioners—tireless, heroic figures crisscrossing their territories at all hours of the day or night. Numerous memoirs by doctors burnish this image. All too little attention is paid to how the work of the practice actually got done.

Downplaying what these doctors knew or could do, many have assumed domestically based rural medicine lacked a "scientific" foundation

(compared to urban, hospital medicine). Generally omitted from the nostalgic picture is how country practitioners incorporated science into their practices despite their rural locations. Also typically glossed over is the extent to which such doctors could not have managed without direct assistance from their spouses. Properly mined archival records present a rather different model of knowledge-making and knowledge-use in rural medicine.

This paper seeks to complicate the standard narrative account of the growing dependence on scientific break-throughs in major medical centers during this period by demonstrating that knowledge production also transpired in rural settings. Though the science used and produced by rural general practitioners (GPs) was unimpressive by modern academic standards, lab work and the use of emerging technologies were crucial to a good country practice. Further, gendered notions of who was using the science need to be challenged. Many a GP's wife, even when neither a nurse nor scientifically trained, learned to be a laboratory technician and to run both diagnostic and treatment equipment.

The analysis in this paper is based on a unique archive of letters and other papers that detail the career of one GP in rural New England and illustrate how his wife, with no background in science, mastered the tasks essential to helping ground her husband's practice scientifically. Letters written by the doctor and by his wife to family and friends offer evidence that claims on science by the academy and by city doctors omit much of the story.

Jessica VAN HORSSSEN | York University, Canada

Community as laboratory: the medical experiment that was the town of Asbestos, Canada

Medical experimentation on human subjects without informed consent was illegal in many countries following the Second World War. This illegality did not necessarily prevent governments and corporations from experimenting on citizen workers, especially when industrial success depended on the results of these studies. This was seen in the community of Asbestos, Canada, location of the largest chrysotile asbestos mine in the world, the Jeffrey Mine. Throughout the 20th century, the American Johns-Manville Company (JM), which owned the mine, used workers as they would test mice, and the entire community of Asbestos as a giant, living laboratory.

The people of Asbestos were not aware that they were being used as part of a large-scale industrial hygiene experiment. In this single-industry resource community, the local population was instead thankful for the perks the American company brought the town, including a JM-run health care facility where each Jeffrey Mine employee received yearly checkups. Under the guise of receiving free, state-of-the-art medical care, workers were monitored as their diseases progressed, were given experimental treatments without their knowledge, and when they inevitably died, their bodies were secretly autopsied, and their lungs taken across international borders to company laboratories without their consent.

This paper will examine the scientific experts who manipulated medical evidence in this large-scale community-cum-laboratory, to challenge the growing consensus that asbestos was dangerous to human health. The first recorded death due to asbestos-related disease occurred in 1909; the people of Asbestos were not informed of their asbestos-caused illnesses until the 1970s. Over this 60 year period, JM used Jeffrey Mine workers, and members of the larger community, to gather extensive medical evidence proving asbestos was a hazardous mineral and tracing the progression of the diseases it causes. The company then manipulated this data and published studies in international medical journals to promote the idea that asbestos workers became sick because of lifestyle choices, namely smoking cigarettes. This misrepresentation of evidence highlights important aspects of the use of expertise, the objectivity of the scientific method, and the influence of politics and big business on medical research.

T172. The politics of public health

Fri 26 July, 14:00–17:30 • Uni Place 4.204

T172-A. Public cultures of nineteenth-century medicine

Fri 26 July, 14:00–15:30 • Uni Place 4.204

Chair: Iain WATTS | Princeton University, United States

Margaret DELACY | Independent scholar, United States

The debate over the Manchester House of Recovery: contagion, controversy, and communication

The Manchester Board of Health was created by a small group of reformers in 1796. Almost immediately, the Board launched a plan to open an institution for the isolation and treatment of poor fever patients, euphemistically called the “House of Recovery.” This proposal for the first stand-alone fever hospital in England set off a storm of controversy in a city already divided along political and religious lines.

The House of Recovery was designed to quarantine patients suffering from typhus, which had only recently been identified as a separate disease entity. The word was first used in this context by François Boissier de Sauvages in 1759. In 1772, William Cullen collected many older accounts of fevers under this name. It proliferated among poor workers crowding into the new industrial towns.

Both sides in Manchester agreed that typhus was contagious but differed on the nature and behavior of contagion. The neighbors of the proposed site and their allies claimed that grouping patients together generated more severe epidemics by concentrating the poison of contagion. They feared the disease would spread to nearby homes, placing them at risk and reducing their property values. Contagious emanations might leap walls, seep out of windows, waft from clothing or even ooze out of the cracks in the sedan chairs used to carry patients. The Board argued that the behavior of contagious diseases was well established and that their precautions would ensure that diseases could not possibly escape. The hospital would enhance the health of the city without endangering its neighbors who were governed by “obsolete prejudices, and by opinions that science now disclaims”.

Both sides tried to deploy knowledge about contagion to win the debate. They ransacked old medical treatises, argued over every detail in every report and procured opinions from respected doctors throughout Britain. Strategies included mass meetings, leaflets, letters to the newspapers and threats of lawsuits. The debate forced participants to address details that they would otherwise have skimmed over and to take more absolutist positions. When the Board opened the hospital, the need to retain support forced them to stick to their arguments despite conflicting evidence. Thus contagionism created its own institutions and those institutions in turn perpetuated contagionism.

Rebecca WHYTE | Independent scholar, United Kingdom

Disinfection in the laboratory and the lavatory: theory and practice in local health disinfection policy in nineteenth-century England

Disinfection as a public health intervention enjoyed a resurgence in popularity from the 1870s, with national and local legislation empowering and encouraging local authorities to undertake disinfection of houses, items and people. The parallel trends of the development of germ theories and the increasing focus on preventative public health prompted the development of an integrated programme of disinfection, which, alongside notification and isolation, was directed against epidemic and

endemic infectious diseases. Procedures such as sulphur fumigation, heat treatment and use of chemical liquids were used to purify infected places, people and objects. The underlying rationale was that the increasingly exacting standards of disinfection required in the new era of germ theory needed to be done by professional medical officers of health, rather than the “amateur” public, in order to protect the public health. Technological and chemical change, and new laboratory research, however, presented an increasingly wide range of disinfection methods; choosing the most effective method was a difficult task. Local medical officers of health were expected to negotiate this new and troubling landscape to ensure that their policies prevented disease outbreaks. This paper examines differing practices of local authority disinfection between 1870 and 1914, and the effect that changes in knowledge had over day-to-day action. In particular, I will highlight the ambivalent effect that germ theory had on local disinfection practice and the gap between laboratory based knowledge and evidence derived from practical experience. This gulf in the usefulness and use of knowledge meant that despite efforts to professionalise disinfection, local authority practice increasingly diverged from the ideal promulgated by central government and definition researchers. This tension lay at the heart of seemingly paradoxical changes in disinfection theory and practice in the second half of the nineteenth century, and illustrate the complexities of the impact of germ theory on public health policy.

Graham MOONEY | Johns Hopkins University, United States

Mobilising technology: how municipal disinfection became ‘liberal’ in late-Victorian England

Legislation for infectious disease surveillance (notification, isolation, disinfection and contact tracing) provided government with unprecedented access to the homes and bodies of the poor and a set of tools to destroy and neutralize the biological threat posed by the intimacy of domestic space.

This paper focuses on municipal disinfection in England in the late Victorian period. Until now, historians have suggested that disinfection was accepted simply because the general public became convinced by the discoveries of medical science that showed disinfection killed germs. Whilst bacteriological knowledge certainly was a significant contributing factor, this paper contends that the effective municipal disinfection of homes and material belongings was achieved because it was transformed into a mobile, technologically-sophisticated and unobtrusive practice; that is, it became ‘liberal’.

By utilizing an extensive array of sources at the local and national levels, the paper explores the design of steam disinfection as a safe, self-regulating and easily-managed technology that minimized the ruination of material possessions such as clothes and books and maximized the destruction of germs. I show how the fumigation of homes was largely displaced by disinfection with chemical spraying, which became a portable, rapid and well-directed intervention supposedly capable of reaching the darkest and most dangerous corners of the home. As such, I demonstrate how assumptions about the corporeality of everyday life were built into the material form of disinfection technologies.

Central to this critique is an analysis of the spatial practices of medical science, using the tuberculosis disinfection experiments in Manchester’s public health laboratory as an example. These investigations, which took place in the 1890s under the supervision of Dr. Arthur Ransome and Professor Sheridan Delépine, utilized a laboratory room fitted out to replicate the conditions of domestic space. The experimental materials were taken from the homes and bodies of tubercular Mancunians. Whilst these experiments demonstrate the uncertainties of science and the deeply contingent nature of laboratory research, I also argue that this laboratory was a confident spatial expression of the supposed social and moral relations that were brought to bear in the experimental setting.

T172-B. Topics in eighteenth-century medicine

Fri 26 July, 16:00–17:30 • Uni Place 4.204

Chair: John CHRISTIE | University of Oxford, United Kingdom

Meghan ROBERTS | Bowdoin College, United States

Providing ‘living proof’: inoculation in eighteenth-century France

For centuries, Europeans found themselves vulnerable to the dread disease of smallpox. But in the 1720s, they learned of the process of inoculation from their Turkish neighbors and realized that they could control both the severity and the timing of the illness, thereby increasing their chances of survival. Inoculation was still a dangerous business, however, as it involved purposeful infection with live smallpox matter. Yet as it improved one’s chances of surviving smallpox so greatly, many men and women of letters took it upon themselves to promulgate the technique throughout Europe.

I propose a paper on the major champions of smallpox inoculation in France, the philosophes, and the ways in which they turned themselves and their family members into “living proof,” proof they hoped would sway public opinion in favor of inoculation. Men of letters inoculated their own children and, in the process, turned ostensibly private medical decisions into public demonstrations. By drawing attention to their own families, philosophes were able to acquire more evidence in favor of their theories and — more importantly — to transform themselves into models of what they called “enlightened love.” They depicted themselves as ideal fathers: enlightened parents who relied upon both reason and emotion in making family decisions. They used their domestic lives as a way to teach French parents how to love their children properly, which is to say in the same way that men of letters loved their children. Philosophes thus utilized their families to legitimate their claims about inoculation and about themselves. In doing so, they not only claimed new authority for savants to influence social practice but also transformed the relationship between public and private.

This paper contributes to the study of “knowledge at work” in several ways. It sheds light on how Enlightenment savants attempted to practice their ideas and helps us better understand how Enlightenment thinkers wished to remake their world. Particularly, it encourages to think of the Enlightenment not as an abstract movement divorced from social practice but instead to think about the ways in which savants created small social laboratories, most often using their families, to demonstrate the validity of their ideas. Finally, it contributes to scholarship showing that “knowledge” and “work” were not only public categories but were also private, even intimate, ones.

Rebecca BOWD | University of Leeds, United Kingdom

Extending medical knowledge: libraries, books and provincial medicine in the eighteenth century

This paper explores the relationship between book and library history and the history of medicine in the eighteenth century via a study of provincial medicine in Leeds. The paper capitalises on recent work on provincial medicine by Michael Brown in *Medical Culture and Identity in Provincial England c. 1760-1850* (2011), and discusses the emergence in the mid-eighteenth century of a new breed of provincial medical practitioner who combined specialised knowledge, education and professionalism in their provincial practice. Susan Lawrence has argued for the increasing propensity for ‘hospital knowledge’ in the training of London-based medical practitioners in the mid-eighteenth century and in this paper I suggest that the effects of this were felt further afield. William Hey, the Leeds-based man-midwife and surgeon is just one example of this new breed of professional and knowledgeable provincial practitioner who combined the traditional seven-year apprenticeship with practical

experience of metropolitan medicine. I will also suggest that the emergence of various medical institutions in Leeds in the mid-eighteenth century such as the Leeds Medical Library (1768) can be associated with this development. An analysis of the collections of the Medical Library will suggest its primary purpose was to provide the Leeds medics with the latest medical knowledge and to keep them up-to-date with developments in the profession. Building on the work of Bynum, Lock and Porter (eds) *Medical Journals and Medical Knowledge* (1992) I will suggest that the founding of this library in Leeds in the mid-eighteenth century combined with the knowledge that medicine was one of the earliest specialist periodical markets in Britain helps to highlight the growing importance and organisation of provincial medicine at this time. I will also propose that the collections of the library were a central means by which provincial practitioners maintained their position of expertise. I conclude the paper by arguing that the collections of the library combined with an analysis of medicine in Leeds show that there was an active, learned medical community in provincial England who strove to keep not only up-to-date with professional developments but to contribute to the constantly growing body of medical knowledge in the eighteenth century.

Dayle DELANCEY | University of Wisconsin-Madison, United States

‘Has had the smallpox’: reading debates about inoculation provision, safety, and efficacy in slave sale and runaway advertisements, 1730-1800

This paper presents new research from an ongoing project that explores the nature and extent of eighteenth-century enslaved Africans’ access to smallpox inoculation — and that also considers how this access or lack thereof at once impacted slavery and reflected Atlantic world debates about the safety and efficacy of inoculation. Despite the scarcity of direct historical evidence that inoculation was practiced in more than a few regions of sub-Saharan Africa, many historians posit widespread knowledge and implementation of the technique among enslaved Africans imported into mainland North America. In contrast, other historians cite trading company and garrison records to argue not only that inoculation was uncommon in the sub-Saharan African regions from which most Africans enslaved in North America hailed, but also that unchecked smallpox, aided by mistrust of inoculation among European and North American ‘traders’ and ‘owners’, was one of the hallmarks of Atlantic slavery’s depiction in print advertisements. Examining a Philadelphia case study’s relationship to British-controlled Africa and the British West Indies, this paper explores the historical debates surrounding African American inoculation via the slave sale and runaway advertisements that appeared regularly in the *Pennsylvania Gazette*, eighteenth-century North America’s foremost periodical. Drawing upon a survey of over 2,000 advertisements that appeared in the newspaper from 1730 to 1800, I juxtapose the adverts’ descriptions of enslaved bodies with municipal statistics, trade and auction records, medical treatises, hospital records, and the practice diaries of several local physicians, including Benjamin Rush. I argue that the advertisements illustrate that: (1) smallpox scars reinforced the institution of slavery by facilitating both slave sales and the apprehension of runaways; (2) scars that historians have attributed to “natural” smallpox might in fact reflect inoculated smallpox; (3) moderate smallpox scarring and the notation “has had the smallpox” were used to connote both inoculation and “natural” smallpox; and (4) Philadelphia-area slave ‘owners’ and ‘traders’ shared the doubts about inoculation’s safety, efficacy, and suitability for the enslaved that gripped other portions of the Atlantic world. For these reasons, I argue, slave sale and runaway advertisements embody inoculation’s contested status in the eighteenth-century Black Atlantic.

Henry KREUZMAN | College of Wooster, United States

Alexander Gordon’s empirical arguments for the infectious nature of childbed fever

This paper argues that Alexander Gordon (1752-1799) had a series of empirical arguments that lead him to the conclusion that puerperal fever is an infectious disease. He thus provides a case study of the shift during the 18th century to an empirically based approach to medicine.

Gordon was the physician for the Aberdeen Public Dispensary and treated many of the women who became ill during the epidemic of childbed fever that extended from 1789-1792. This paper first examines the geographic distribution of cases of childbed fever by plotting each case on the 1789 Milne map of Aberdeen. The geographic distribution led Gordon to reject the miasma theory and to seek an alternative causal explanation. A second important observation was when the illness arose. He observed that the onset of the fever never preceded and always followed childbirth and thus focused upon this time as the causal interval. A third and fourth line of argumentation emerges from the detailed records that he kept as the physician for the Public Dispensary. As a result of these records, he observed a pattern linking specific midwives and physicians with who become ill, and he concluded that it was a disease carried by midwives and physicians from woman to woman. Finally, he observed a correlation between the number of cases of puerperal fever and erysipelas (i.e., a recognized infectious fever) and noted that a surgeon can acquire an inflammation and fever as the result of a scratch during a dissection of a patient who died of puerperal fever. As a result of this empirical line of inquiry, Gordon concluded that childbed fever is an infectious disease carried by midwives and physicians.

T173. Medical ethics and psychology

Sat 27 July, 14:00–17:30 • Uni Place 4.206

T173-A. Institutions and ethics

Sat 27 July, 14:00–15:30 • Uni Place 4.206

Chair: Frida WIKSTROM | University of Gothenburg, Sweden

Marianna SCARFONE | University of Venice Ca' Foscari - Université Lyon 2, Italy

Psychiatry in Italy's former colonies

In recent years the question of colonial psychiatry has received a growing attention; the history of psychiatry and the history of colonialism have intertwined and a new subject has entered the field of historiography: it is the peculiar case of a new *otherness* – the lunatic in the colonies – bearing a double “difference”, in which an *alterity* of the “native” at large, is added to a more specific, mental *alienity*.

In my presentation I'd like to illustrate the establishment of psychiatry in Italy's former colonies, through its clinical and institutional mechanisms, its underlying theories and the main actors involved, in order to shed some light on the body of knowledge on which this particular form of psychiatry was based, and above all on its organization and implementation within a specifically colonial system of care and committal. I am going to focus my attention on Libya and Horn of Africa, where in the Thirties health care and public assistance – primarily provided for the benefit of Italian immigrants, but subsequently extended to the local population – took on great importance among the colonial administration's priorities.

My paper will tackle the function and the functioning of the psychiatric institutions in the colonies, in their relation with the “social policy” of colonial administrations; the process of theoretic and clinical elaboration and its incorporation into the broader colonial project; but also the trajectories of the protagonists: doctors coming from the mother country operating in the colonies; patients – Italian or “indigenous” – suffering

from mental disorders in the colonial territories, sent to the mother country asylums before the implementation of a system of care *in loco*.

As far as regards the history of the protagonists in the field of psychiatry in the Italian colonies, two analytical approaches were adopted. These were particularly pertinent to the material discovered, namely: the reconstruction of the background and careers of those physicians involved, on the one hand, in order to investigate the cultural-scientific transfers that took place among mothercountry and colonies but also among different colonial situations (for example between Libya and the French Maghreb); and the reconstruction of the histories of the patients, on the other: the physical transfers of psychiatric patients from Addis Ababa, Asmara, Mogadiscio to Naples asylum and from Libya to Palermo asylum.

Silvia CHILETTI | Centre Alexandre Koyré, Histoire des sciences et des techniques, Paris, France

Knowledge of Unconsciousness: pregnancies and expertises - 19th and 20th centuries

I propose to analyze the role of psychological expertises in some cases of infanticide at the turn between the 19th and the 20th century. The study focuses on Italian cases, the source material being drawn from criminal records from the State Archives of Florence, but I will be extending my considerations to international literature and sources about psychiatry and legal medicine, specifically in France.

My aim is to examine the interplay of concepts and sets of knowledge which are used by physicians, forensic scientists or psychiatrists in order to answer two main questions put forward by judges: Is it possible for a woman to be pregnant without realizing it throughout the entire gestation period? And: Can the birth of a child take place without the woman being aware of it?

These issues relate to subject's sensations and psychological states, although the expertises in question are not exactly psychiatric expertises in the proper sense of the word, because the goal of the examination is not necessarily to detect mental disorders that may annul or lessen the defendant's criminal responsibility. Even if physicians appear as “experts” of pathological states (physical or mental) of the human being, the knowledge referenced in their answers is often unconnected to the domain of pathology.

Nevertheless, this knowledge is perceived and acknowledged as “expert” knowledge, on the one hand because of the privileged role of the forensic physician, and on the other hand since its reasoning utilizes the methodology (specifically the inductive method) of modern experimental science, a field that forensic medicine claims to be a part of. Hence, what kind of knowledge is produced by this kind of expertise? And: What are its “effects of truth” within the judiciary context of the trial and among the scientific community?

My conclusion will focus on the contemporary issue of pregnancy denial as a phenomenon discussed in contemporary medical and scientific debate. Through analyzing the historical emergence of psychological knowledge on pregnancy and the states of consciousness that accompany it, my talk could initiate a discussion on the epistemological challenges in this controversial category of Contemporary psychopathology.

Octavian BUDA | Carol Davila University of Medicine and Pharmacy, Romania

‘Bedlam’ of Bucharest: the origin of institutional psychiatry in Romania, Eastern Europe, 1839

About 1839 the first specialized asylum for the insane, originally an Orthodox monastery (the Marcuța Asylum, then near Bucharest) opened its doors to individuals considered insane and beggars; however, none of the doctors who worked there had any prior training in psychiatry. This situation continued until 1866 when Alexandru Sutz (Alexandros Soutzos) was appointed as assistant medical doctor,

following the completion of his doctoral studies in Paris. For 40 years (1867-1878 and 1880-1909), Sutzu was the director of this medical institution, and he made a significant imprint on the development of psychiatry in Romania. All the time Sutzu was trying to turn this asylum from a place of isolation and detention into a modern medical institution aimed at returning the cured insane individual back into society. He made sustained efforts to improve the methods of occupational therapy by organizing special workshops/workstations for the inpatients. John Conolly's abolition of mechanical restraint at the Hanwell Asylum in 1839, a decision which by 1850 had been adopted in almost all asylums throughout England, had also been adopted in Bucharest Marcutza, around 1860. Sutzu retired in 1909 from the Marcutza Asylum (which had by then been renamed the Marcutza Institute). This presentation provides an insight into the origins of modern clinical psychiatry and medical advances in Romania, and to the contemporary personalities in Romanian and Eastern European medicine.

T173-B. Late twentieth-century psychology and psychiatry

Sat 27 July, 16:00–17:30 ▪ Uni Place 4.206

Chair: Alice WHITE | University of Kent, United Kingdom

Frida WIKSTROM | University of Gothenburg, Sweden

Moving walls: the process of discharges from psychiatric care in Sweden during the second half of the twentieth century

During the second half of the 20th century a fundamental change of psychiatric care was witnessed in Sweden (as in many other countries). The number of hospital beds decreased and so did the number of care days, institutions liquidated and closed; the psychiatric space changed. In this paper, I study this development and process focusing on the spatial changes. The main question is: in which spaces were the patients placed during the time when the large mental hospitals started to shrink and close? To study this, the process of discharges is in focus and the sources are material from the committee of discharges from roughly 1950 up to 1990. One of the driving hypotheses in the paper is that the power of enclosure space does not disappear; it rather moves and takes on different shapes. What distinguishes the psychiatric care during the second half of the 20th century is a kind of flexibility that dissolves the difference between inside and outside; the walls of the institutions are moving and indefinite.

Fredy MORA-GAMEZ | University of Leicester, United Kingdom

Testing psychological treatments in prisons: the assemblage of behavior control in Colombia

The relationship between psychology, its intervention techniques and the public confrontations regarding the first applications of psychological techniques in Colombian prisons during the 1970s is approached. In this sense, the disciplinary demarcation of psychology as a result of technical devices circulation is described and some of the controversies around the usage of modification techniques such as behavioral economies in prisons are reconstructed. Through the analysis of institutional files, interviews and public media different interest groups are identified as their rhetoric and discourses are addressed. Thus, the confrontation between the Sisters of Charity in charge of the prison, a psychology student, the prisoners, the liberal and conservative parties and the Catholic Church in Colombia are reconstructed and mutual imputations of power, manipulation and control are outlined among such actors. Finally, the implications of the legitimization of experimental psychotherapies in Colombia and Latin America are discussed; the connections between the circulation of these technical devices and the establishment of North-South academic and political relations are also explored as the basis for the configuration of Latin American psychology.

Annika BERG | Stockholm University, Sweden

Citizenship distorted: paranoia querulans and the borders of democracy

From the second half of the Nineteenth Century, pathological protesting was identified as a psychiatric problem as well as a menace to society. In this paper, I will explore how the concept *paranoia querulans* was put to work in the categorization of certain troublesome people, legitimizing their confinement in mental institutions, in Sweden in the 1930s and 40s.

Diagnosing paranoid querulants was not just about sorting some people out as a distinct category within the greater category of the mentally ill. It was also about distinguishing them from people who were excessively angry, quarrelsome or even violent, but not pathologically so. The difficulty of distinguishing mental health from insanity took a certain twist in the case of "real" querulants, who were categorized as such on the criteria of appearing quite sane, except for their inordinate fixation on some wrong purportedly done to them.

Somewhat paradoxically too, the kind of behaviour that used to motivate the confinement of querulants - speaking one's mind by writing letters to authorities - also served as the key to their release. In a way, the querulant could be seen as a person who very actively exercised her civic duty. From the perspective of the modern, recently democratized state, all citizens ought to be formed, or preferably form themselves, into self-governing, productive subjects. Buried within this ideal, however, lay the implication that people should conduct themselves in directions that were beneficial for society. The querulant, in contrast, steered herself in the wrong direction, or just too aggressively. Obviously, there were borders where good citizenship turned bad, excessive and ugly - even crazy. But how were these borders drawn in practice?

In the interwar years, as well as today, psychiatric care aimed at social control and protection. At the same time, society had an interest in discharging psychiatric patients, on trial or permanently, for medical as well as economic reasons.

The case files that I study in this project make it possible to scrutinize querulousness and processes of negotiation from the patients' perspective as well as the doctors' and the authorities', and therefore examine power as a complex, relational phenomenon.

Judith FRIEDMAN | National Institutes of Health, United States

Is seeing believing? Observations of genetic anticipation in schizophrenia

For over 150 years, psychiatric researchers have noted familial patterns of inheritance in schizophrenia, once known as dementia praecox. In certain families in which the disease was common there appeared to be a decrease in age of onset of the illness from one generation to the next, a pattern known as 'anticipation'. By the mid-twentieth century findings of anticipation had fallen into disrepute and were believed to be the result of statistical bias rather than biological reality. This changed in the early 1990s with the discovery of a unique form of dynamic mutation in two other diseases which had been associated with genetic anticipation - myotonic dystrophy and Huntington's disease. Having found a causative mechanism which related the decreased age of onset of illness to the increasing size of DNA repeats within the disease gene from one generation to the next, researchers set out to discover if similar mutations lay behind findings of anticipation in other diseases, including schizophrenia. In spite of the best efforts of several groups of researchers, no such mutation has yet been found. This has led to a clash of opinions within the field between those who insist that their clinical findings of anticipation in families suffering from schizophrenia are accurate and those who deny those findings based on statistical arguments and the lack of an acceptable biological mechanism. I intend to use this case study to explore the ways in which knowledge is created in the field of medicine and to examine how current approaches tend to

privilege the findings of molecular genetics and downplay the value of clinical observation.

T174. Twentieth-century medicine

Sat 27 July, 09:10–15:40 • Uni Place 2.219

T174-A. Cancer

Sat 27 July, 09:10–10:40 • Uni Place 2.219

Chair: Peter C. KJÆRGAARD | Aarhus University, Denmark

Rui Manuel Pinto COSTA | University of Porto, Portugal

Medical discourse, cancer science and public health strategies in the emergence of the fight against cancer in Portugal, 1904-1923

This paper focuses on the scientific and political context that where in the origin of the institutionalization of the fight against cancer in Portugal over the first quarter of the 20th century. From the growing impact of an intense medical discourse about the disease to the first statistical studies, as well as the need to increase local scientific work on cancer science, all these elements saw the unfolding of the first projects that were at the origin of the Portuguese Institute for the Study of Cancer in 1923. It was not without tensions and moments of political disinterest that the project materialized. Under the newly implemented Republican political guidelines since 1910, there was a desire to prompt a greater state intervention in matters concerning public health, although the fight against cancer was perceived more as a matter of mere medical research and medical training than a serious public health problem demanding specific hospital structures.

Neeraja SANKARAN | Yonsei University, Korea, Republic of

Cancer viruses at the Rockefeller: James B Murphy and the fate of RSV research beyond Peyton Rous's discovery

Knowledge is not necessarily, indeed seldom, put to work in the way that the initial producers of that knowledge envisioned and the early history of research on cancer viruses at the Rockefeller University offers a good case study of this point. The idea that viruses might be involved in the causing cancers or tumours was proposed in 1911 by the Rockefeller University physiologist Peyton Rous when he found that a cell-free extract of tumour tissue was capable of transmitting chicken sarcoma to unaffected fowl. Arriving at the Rockefeller around the same time, James B. Murphy a young medical researcher joined Rous in studying the tumour problem and the two men published many papers reporting the results of their investigations. But the knowledge gained from same experiments resulted in diametrically opposite conclusions by the two men. Although Murphy agreed with Rous on the nature of the sarcoma - that it was a true malignancy - he disagreed on the issue of its cause. Rather than viewing the causative agent as an exogenous virus, Murphy considered it to be more in the nature of an "enzyme," or some other endogenous principle, i.e. from within the cell, highlighting the different thought styles within biology at the time. While Rous shifted his attention to blood physiology within a few years of his discovery and only returned to the problem of cancer viruses in the 1930s using the Shopes papilloma virus as his experimental subject, Murphy, who became the head of Cancer Laboratory at the Rockefeller, continued to investigate the nature of the sarcoma and its cause. By the 1930s he had concluded that the sarcoma was a result of a somatic mutation and that the RSV was in the nature of a "transmissible mutagen." Meanwhile others such as William E. Gye and Christopher Andrewes in England who had begun to work on sarcoma during the 1920s were more sympathetic to Rous's

initial conception of the tumour agent as a virus. Murphy's contributions were thus instrumental in keeping open a dialogue through which tumour viruses survived as research objects despite skepticism, largely because of the ambiguity surrounding the nature of what a virus was during that period. In this paper, I examine the ways in which the knowledge about sarcomas gained by Murphy was put to work, not only in understanding bird sarcomas but also in getting a handle on their etiology.

Carsten TIMMERMANN | University of Manchester, United Kingdom

Coping with recalcitrance: futility, frustration and failure in the history of lung cancer research

Much excellent work has been published in recent years on the history of cancer: research, the treatment of cancer, and the history of individual malignant diseases. In these histories, as in the historiography of medicine more broadly, progress narratives easily outnumber histories of failure and disappointment. Historians of science, technology and medicine by and large, tend to display a somewhat paradoxical attitude to progress. While a declared aim has often been to contextualise practitioners' claims about scientific and technological progress, we have nevertheless tended to focus on stories that epitomize such progress: innovative surgical procedures, artificial organs, the place of the laboratory in medicine, new medical technologies or other science-driven innovations such as medical genetics.

My paper aims to contribute to the history of failure and frustration in science, technology and medicine. My case study is lung cancer research, mostly in Britain, and much of it funded by the UK Medical Research Council. When historians have written about lung cancer, then mostly in the context of the successful epidemiological work leading to the identification of tobacco smoke as the main cause of this disease, which has acquired iconic status. I will look at clinical research: the mostly futile quest for a cure. Chances of survival for patients diagnosed with lung cancer have improved very little over the last three decades; surgery as the mainstay of therapy hardly changed between 1950 and 2000. Attempts to apply approaches such as chemotherapy, successful for other cancers, yielded frustrating results. My paper addresses how clinical researchers, patients, and others involved in—unfortunately more often than not—futile efforts to revolutionise the treatment of a recalcitrant disease, have dealt with this dilemma. Responses, as I will show, ranged from resignation to soldiering on.

Fanny H BROTONS | Spanish National Research Council (CSIC), Spain

Cancer sufferers' knowledge and expectations about therapeutics in the second half of the Spanish nineteenth century

During the second-half of the Spanish nineteenth century, a variety of articles and advertisements detailing treatments that cured cancer proliferated in both the medical and the general press. Cancer therapeutics included powders and ointments made of arsenic, mercury, sulphur or other chemicals, the application of ice, the use of galvanic currents, decoctions of roots and plants, cauterizations, bathing in a spa, restraining a depressing passion of the anima and, last but not least, a tumour removal surgery. The news praising the suitability of one or another of these treatments for obtaining the definitive recovery of patients were, nevertheless, as common as those news related to the frequency of relapses, the complete uselessness of a given prescription, and even warnings against its use because it would only increase cancer malignancy. Cancer was a badly known disease, and medical practitioners proceeded -rather unsuccessfully- by trial and error in their efforts for curing their patients. What is more, innovations in therapeutics tended to lie on evidence of the efficacy of a remedy for curing patients suffering from other diseases, particularly those that were capturing a greater social and institutional attention at that time; i.e.: tuberculosis, syphilis or hysteria. Within the surgeons' community, however, there was a particularly solid and prolonged conviction in that removal surgery

was the only possible way of curing cancer. The huge proportion of relapses did not invalidate the adequacy of the scalpel. It only showed technological limitations that could progressively be overcome with the advances in chemical anaesthesia, antiseptics and, from the turn of the twentieth century, the dissemination of prevention advice. Drawing mainly on volumes of clinical records, surgery treatises, and both medical and general press of the second-half of the Spanish nineteenth century, my presentation will focus on exploring the available knowledge and expectations of cancer sufferers in relation to the therapeutics of this dreaded disease, with a particular emphasis in patients' hopes and fears about removal surgery.

T174-B. Asian, Pacific and Western medicine

Sat 27 July, 11:10–12:40 ▪ Uni Place 2.219

Chair: Paul BERMAN | Independent scholar, United States

Man Sing CHAN | University of Hong Kong, Hong Kong

LAW Yuen Mei Vicky | City University of Hong Kong, Hong Kong

Knowledge transfer as cooperative conflict: Benjamin Hobson (1816-1873) and the translation of western medicine in late-Qing China

Benjamin Hobson came to China in 1839, after receiving full training in medicine at University College London, and served for the next twenty years as a medical missionary in Hong Kong, Guangzhou, and Shanghai. He returned to England in 1860 on account of ill health. From 1850 to 1859 he published a series of treatises on western medicine in the Chinese language, the first of its kind in Late Qing China, spanning practically the full range of medicine of the time: anatomy, physiology, surgery, obstetrics, paediatrics, general medicine, and materia medica. He was assisted in this tremendous enterprise by his "Chinese teachers", notably Wong Ping and Guan Xifu, who were more than amanuensis, taking on an active role in reinterpreting and reformulating Hobson's missionary medicine for a Chinese audience entrenched in the Confucian intellectual tradition. This paper examines the subtle conflicts, both psychological and cultural, between Hobson and his Chinese assistants, and the ultimate asymmetrical compromise in the new hegemonic formation of scientific knowledge, drawing largely from two draft manuscripts of Hobson's, *Xiyi luelun digao* 西醫略論底稿 and *Fuying xinshuo* 婦嬰新說, recently discovered and now kept in the Australian National Library.

Lena SPRINGER | University of Westminster (London, UK), and University of Vienna (Austria), United Kingdom

Inventing experts: 'Chinese' medicine on the eve of east Asia's transition to modernity

Taking intellectual and social developments prior to China's Republican period into account, we become aware of late-imperial roots of East Asian discourse on institutionalized health care. Contrary to what Chinese medical history publications generally claim today, reformers at the turn of the century envisioned medicines in China as universal, rather than particularly Chinese: The scholarly debate on China's position in world history led to the revolutionary claim for public health care. While Japan had set a model by eradicating traditional medicine and replacing it by public hygiene, the method for China included also selected contents from ancient scripts on medicinal products.

This paper collects casual remarks and revolutionary arguments by scholars who – even though they did not work as physicians themselves – were concerned about the status relations in medicine. They saw health care as a societal phenomenon crucial to any beneficial outcomes of a cultural and social turmoil in China. The aim is to make their voices heard which belong neither to insider discourse among practitioners nor

can they be just subsumed to the later revolutions of the Republican period.

Confronted with diverse medicines in China, these late Qing reformers worried about how to codify both practitioners and the written canon, yet to be distilled from re-ordered and re-read ancient scripts. They hoped by distinguishing scholarly, charlatan, or experienced prescribers of medicines and ancient scripts to supply hints about medicinal substances, which could still be identified in the flora, fauna and minerals of the vast land. With a new systematized order of society and worldview, the application of medicines was expected to benefit not only single human bodies but in fact the body politic in a global transition. Ideas about this ordering varied widely.

Thus, a new type of experts was expected to help human beings, throughout the country just as anywhere in the world. Contrary to later historiography in China, Chinese medicine was imagined as hopefully turning into a world medicine, with China's innovative scholarship and revolutionized organizational structures as its centre. Earlier scholars and physicians were regarded as having overlooked potential medicinal substances in their sources, and the current strategies of prescribers as lacking philological training. "Revolution", then, meant consulting the same sources in advanced ways.

Rachael CAVE | University of Birmingham, United Kingdom

Island isolation: a history of the Makogai Leprosy Hospital, 1911-1969

This paper explores the patients' experience of life in compulsory isolation at the truly unique, yet largely forgotten, Makogai Leprosy Hospital, Fiji. This rarely studied institution has greatly influenced the history of British dermatology and so in addition to communicating the fascinating story of the Makogai Leprosy Hospital this paper also aims to demonstrate the value in reclaiming lost knowledge of these institutions. Admitting patients from all over the South Pacific, this island once played host to over four thousand men, women and children, forcibly isolated there and removed from the eyes of the world. Unlike many of its contemporaries, including the famous Molokai colony of Hawaii, the Makogai leprosarium immediately gained a reputation for the humane treatment of its patients, the high quality of its care, and the love and attention given to the patients' physical, mental, emotional and spiritual needs. An examination of the Fijian Department of Health's records, the accounts of the Pacific Leprosy Foundation and the archives of the Missionary Sisters of the Society of Mary, as well as both patient and staff interviews have all informed this research. The level of isolation endured by patients will be explored, preceding a discussion of patient attitudes towards segregation and the fascinating structure of the enforced, multi-cultural communities formed on Makogai. The emotional strain of separation from friends and family was unsurprisingly hard to bear, but for many the disfiguring aesthetics, putrid smells and enfeebling disabilities characteristic of this disease had resulted in social ostracism previous to their admission. The acceptance of the community of Makogai, was, for some, very healing. The wider social, political and cultural significance of leprosy in the South Pacific is therefore implicated in this discussion. By unearthing this wealth of historical knowledge, this paper demonstrates how such a small institution can change the face of society and even the face of medicine.

T174-C. Institutions

Sat 27 July, 14:10–15:40 ▪ Uni Place 2.219

Chair: Margaret ROSSITER | Cornell University, United States

Paul BERMAN | Independent scholar, United States

The Pratt Health Cottage Hospital, Amherst College, Massachusetts: possibly the first in-

hospital 'aseptic barrier nursing' unit in the United States

In 1896 noted Brooklyn architect William B. Tubby was invited by Amherst College graduate George D. Pratt to design an infirmary for the college. The third floor, an isolation unit for contagious diseases, was an integral part of the building a design not seen in 19th century hospitals. It had one entrance, and a balcony surrounded by cubicles, a plan known as "aseptic barrier nursing". Historically the first such unit was credited to the Pasteur Hospital in Paris in 1901. This paper utilizing manuscripts from the Amherst College and Columbia University Archives and newspapers of the period, explores how such an advanced design appeared in Amherst, Massachusetts in 1897.

Anne HANLEY | University of Cambridge, United Kingdom

Venereology at the polyclinic, ca.1899-1913

Historians writing on nineteenth and early-twentieth century medical debates regarding modes of venereal disease transmission, treatment and prevention have rarely addressed the fundamental question of venereological training. It has generally been assumed by historians that doctors possessed an adequate working knowledge of the symptoms of venereal disease, as well as the treatment methods available to patients. Yet the limited presence of venereology in the undergraduate curriculum and in optional, postgraduate training courses raises important questions about the state of the average practitioner's venereological knowledge and clinical skill. Even towards the end of the nineteenth century when specialisms were emerging as distinct and important disciplines within an integrated body of medical knowledge and practice, the place of venereology remained problematic. Was the dissemination of new ideas about the aetiology, treatment and prevention of venereal disease impeded by a lack study? Did the shortcomings in medical education affect the accuracy of diagnosis and the efficacy of treatment regimes? Was this lack of systematised learning a product of limited knowledge and clinical skill? These questions need to be addressed if historians are to gain a more nuanced understanding of the nature and limitations of clinical practice, of the dissemination of knowledge among medical professionals, and the impact of this upon the care of venereally-diseased patients.

In 1899, the *British Medical Journal* enthusiastically announced that a new postgraduate teaching college was soon to be opened in London. The aim of the Medical Graduates' College and Polyclinic (MGC) was to provide continuing education to general practitioners, focusing principally on specialisms otherwise omitted from the undergraduate curriculum. Although lecturers at the MGC assumed a certain degree of knowledge and skill among their student-practitioners, they were also fully aware of the gaps in their and their students' venereological knowledge. The College's courses were intended to refresh knowledge and to introduce practitioners to new knowledge claims and clinical practices. This paper examines the work conducted at the MGC in an attempt to understand how venereological knowledge was produced and disseminated among medical practitioners at the turn of the twentieth century.

José Carlos AVELÁS NUNES | University of Coimbra, Portugal

My house is white, black is my disease: the history and development of medical and architectural tuberculosis sanatoriums in Portugal and worldwide, 1870-1970

Tuberculosis is the pinnacle disease since the dawn of the nineteenth century to the twentieth century, the carnage of deaths in Portugal and World. The constant prophylaxis and treatment experimentation is the fuse creating an architecture system – the sanatorium - suffering evolution and metamorphosis through the current social and medical program.

Although the strong experimentalisms in medicine due to medical staff, prophylaxis and treatment of tuberculosis have as big (and only) pillar:

the architecture. On one hand, for control purposes, and also for the possible control of the disease and traces of curing, whose paradigms vary over more than a century.

Thus, the architecture of these buildings is no longer a "cocoon", a hotel to be a comfort provider on his deathbed, but a place of health, environment of prosperity, a container of medical investigations which do not see the disease as an effective treatment in the short or long term: it was born a proprietary system, never before used, with technical architects, medical technologies and working with a single purpose: healing.

Although Portugal has been embryo sanatorium equipment worldwide, was also influenced at schools of architecture - and examples of what was being built in the German and French models. Over eighty sanatoriums are metamorphosing throughout his life, watching (or serving as a pillar) to the "new medicine", the ways to face the diseases, suffering transformations such as tremendous buildings, almost urban-scale-type, or even simple houses. The sanatorium is, per excellence, the system that makes the hinge between architecture to modern hospital care.

In these 100 years, the connection between medicine and architecture, nationally and internationally, will be scrutinized in this paper, focusing on mobility of medical knowledge and the doctors, the repercussions hygienist in typologies and social experiences, the importance of status and power as centers of decision, a close link architecture and architects, styles and its vicissitudes in the history of medicine and medical technology poring over a particular disease: tuberculosis.

T175. Contemporary medical practice and ethics

Fri 26 July, 09:10–12:40 • Uni Place 3.205

T175-A

Fri 26 July, 09:10–10:40 • Uni Place 3.205

Chair: Sally HORROCKS | University of Leicester, United Kingdom

Jole SHACKELFORD | University of Minnesota, United States

The transplantation of timing in biological research

Recent developments in human organ transplantation have created an interest in the cultural meanings of transplantation. The problem of identity is manifest in the case of a face transplant, but in principle pertains to transplantation of other organs as well. Fundamental to these concerns is an understanding of the meaning of identity for a part and therefore what exactly is being transplanted. The contours of this problem were explored in the ancient and medieval thought experiment of the boat that is replaced piecemeal over a period of time, but in these discussions, identity was directly associated with the physicality of the parts and the relationship between the identities of parts and the identity of the whole. Absent from them is consideration of the functions of the parts and implicitly also the relationship between function and identity. This way of framing the problem of transplantation and identity persists today in considerations of human transplantation. While individual recipients may claim to experience unfamiliar dreams or other affects that they attribute to a transplanted organ and its donor, the scientific world regards the functions of these transplanted parts in terms of homologies and physico-chemical processes. Consideration of functions are in this sense structure-specific, not specific to the individual part as a unique identity. Indeed, the assumption of homology is crucial to the logic of transplantation—one can restore a function by swapping out a dysfunctional part for a functional one. Considerations of individual identities are thus considerations of structures.

Transplantation of functions, however, is fundamental to knowledge-making in the biological science of chronobiology, which comprehends the temporal nature of living substances generally, but more specifically the study of biological rhythms. In this paper I will explore the historical development of the idea that timing is a component of identity—definitive of function and thus behavior—and document the transplantation of timing structures (biological clockworks) as a basic research methodology for investigating the ontology of biological rhythms. The major historical period under consideration will be the decades beginning with surgical transplantation of timing structures in 1950s England and culminating with the successful splicing of DNA segments to elucidate cellular timing mechanisms in the 1980s and 1990s.

Quintino LOPES | University of Évora - Portugal, Portugal

The support provided by the Rockefeller Foundation and the National Education Board to neurologists and neuro-surgeons in Portugal, 1929-36: the case of Egas Moniz

The National Education Board (JEN) and the philanthropic body, the Rockefeller Foundation, played a crucial role in funding the participation of Portuguese researchers in international scientific communication networks.

The study of a collection of documents relating to the JEN, following the recent granting of access to the Camões Institute archive in Lisbon, has highlighted the extent to which this Portuguese government agency, along with the Foundation, provided support in the early 1930s for research in the fields of Neurology and Neuro-surgery.

The present paper seeks to show how these bodies provided crucial support for the production and dissemination of research carried out by Egas Moniz and those who worked alongside him, as well as honouring them and promoting the recognition of their scientific work.

This included scholarships to institutions both at home and abroad, including the London Hospital, subsidies granted to the Institute of Neurology of the Faculty of Medicine of the University of Lisbon, funding for academics to travel abroad and present papers at international scientific meetings and the award of honorary doctorates, and support from the JEN for international conferences chaired by Egas Moniz. Thus a range of means of support was provided for the research carried out by the future Nobel prizewinner and his associates. We show how the image he projected of himself as a scientist who was purposely held back by the Portuguese state during the dictatorship, a portrayal which has endured up until the present at the national and international level, is at odds with the evidence we have found in the above-mentioned archive.

*This work is financed by funds FEDER through the Operational Competitiveness Factors Program (COMPETE) and national funds through FCT (Foundation for Science and Technology) by the project HC/0077/2009.

Chia-Ling Wu | National Taiwan University, Taiwan

Excluding unmarried women: assisted reproductive technology governance and access politics in Taiwan

This paper investigates how the sociotechnical network of assisted reproductive technologies (ARTs) has shaped and reshaped the gender regime for the past 25 years in Taiwan. Data for this study include archives, participant observation, and in-depth interviews. I first examine the social process of how certain social groups, including singles and lesbians, have been excluded from the access of assisted reproductive technology through governmental regulation. Although the Ethical Guideline on ART of 1986 specified that only married couples were the legitimate users, the debate over whether single women should be included continued for more than two decades. Various social actors – legislators, bioethics scholars, law experts, medical doctors, Taiwanese Society for Reproductive Medicine, and feminist groups – have

negotiated in the public space of deliberation to maintain or reshape the gender order and ART regulation. These social groups configure women differently and mobilize diverse gender discourse for contention. While in the legal arena, the official regulation continues limiting the access of ART to married heterosexual couples, including the recent Human Reproduction Law of 2007, single women, lesbians and gays have formed their own sociotechnical network to fulfill their reproductive needs. Doctors, brokers, celebrities, feminist organizations, and lesbian activists participate in the network building with diverse or even conflicting interests. I thus argue that although the stratified biomedical citizenship excludes gendered marginals, reproductive innovation and new reproductive subjects are achieved through a much invisible but dynamic coordination among different social worlds.

T175-B

Fri 26 July, 11:10–12:40 - Uni Place 3.205

Chair: David KIRBY | University of Manchester, United Kingdom

Duncan WILSON | University of Manchester, United Kingdom

Essential or obstacle? Why Britain doesn't have a national bioethics committee

Recent decades have witnessed a profound shift in the ways that biomedical knowledge is discussed and applied. Issues once left solely to doctors and scientists are now considered by a diverse array of professionals: including philosophers, lawyers, social scientists, theologians and others. This new configuration, which took shape in the 1970s, goes by the name of 'bioethics'. Sociologists and historians who explain the growth of bioethics in recent decades share a number of core assumptions. They argue it has become a valued socio-political enterprise because it constitutes an important component of post-industrial 'knowledge economies'. Bioethics, they claim, performs a vital role by helping legitimate biomedical research: resolving the differing views of citizens, professionals and other stakeholders to produce guidelines for new procedures. In this worldview, the importance of bioethics is confirmed by the political establishment of national ethics committees across Europe, in the United States, Asia, Australia, Canada and elsewhere. Authors argue these national committees not only develop new guidelines and laws, but also ensure the credibility of the country in question by showing it to have a rigorous and accountable regulatory framework.

But these explanations have their limits, and are not universally applicable. While broad models are certainly appealing, we need to appreciate how nationally specific factors shape the contours and determine the influence of bioethics in specific locations. In Britain, bioethics has certainly become an important and high-profile enterprise, with 'ethics experts' discussing and helping regulate many procedures. But in a marked contrast to other countries, successive British governments have refused to establish a national ethics committee. This paper outlines why this is the case. I show that despite support from bioethicists and prominent doctors during the 1980s, politicians argued that a national committee would obstruct research and politicize ethics. I then detail how this reluctance led supporters to establish an independent Nuffield Council on Bioethics in 1991. I also show that while council members celebrated their independence from government, it ensured that their policy recommendations were largely ignored. I close by considering whether the absence of a national committee has limited the growth of British bioethics or whether it has, in fact, worked to its advantage.

Kelly KOIDE | University of Sao Paulo, Brazil

Does science need a politically engaged epistemology? A case study on the role of social and ethical values on Chagas disease investigations

In this paper, I aim to identify the different cognitive, contextual and social values involved in epidemiological research on Chagas disease. As it is considered as a 'neglected tropical disease' by the World Health Organization, I will try to unfold the many senses of 'neglected' and in which sense different non-cognitive values can be manifested in research on this disease through a pluralism of disciplines and methods. The point of departure of this investigation is a model that explains the dynamics of scientific activity, developed by Hugh Lacey (*Is science value-free?*, 1999), based on the notion of strategies of research, in which scientific research has to be socially framed. I will try to show that the social, political and economic conditions of certain populations, which define their 'neglected' character, constitute a perspective that needs to be considered in epidemiological research. Finally, this perspective is defined in the moment of adoption of strategies of research that reflects the social and ethical values adopted by scientists in Chagas disease investigations.

At the outset, Chagas disease's classification as a 'neglected tropical disease' shows the importance of the role of social values reflected in strategies of epidemiological research and in the evaluation of public policies for the control and treatment of the disease. Moreover, it is also necessary to attribute a role to non-specialists in research – more specifically to the ones that are infected by this disease or that live in risk of being contaminated. After all, when scientists elect the priorities of research with the populations affected by Chagas disease, whose contamination is related to the neglected character that certain populations have in society, social scientists, anthropologists, epidemiologists and ecologists could adopt particular social values and, in doing so, develop locally appropriate and relevant research.

Finally, an evaluation of the progress of science in terms of its social progress (in the development of drugs, vaccines and public health measures) can only be realized through methodological, strategic and disciplinary pluralism. This analysis of scientific activity, that does not exclude its social dimension, interprets science as sensible to the contexts and interests that guides it and to understand the different senses in which Chagas disease is a neglected one.

Christina BENNINGHAUS | University of Cambridge/Universität Bielefeld, United Kingdom

Trans-uterine tubal insufflation: the making of a standard procedure in infertility diagnosis

During the 1920s, a new diagnostic method – tubal insufflation – was introduced into gynaecological practice. It was used to assess the patency or blockage of the fallopian tubes, a question central to the diagnosis of female infertility. Developed by I. C. Rubin in the years before 1919, the method spread quickly. This paper will look at the process in which tubal insufflation developed into a standard procedure. Geographically, the paper concentrates on Germany where the method was widely discussed amongst gynaecologists. Several modified versions of the Rubin test and the relevant equipment were developed amongst which a rather simple apparatus known as the "Tubenschneutzer" was especially successful.

As the paper will show, tubal insufflation was almost immediately accepted on a theoretical basis but proved difficult in practice. The new device led to diagnostic results which were very difficult to interpret. Throughout the 1920s and 1930s, doctors compared the results produced by tubal insufflation with the information gathered by other diagnostic means. Statistics published in medical papers and dissertations showed that the prognostic value of tubal insufflation was, indeed, limited.

Using an approach inspired by ANT, the paper reconstructs the process by which tubal insufflation developed into a standard procedure by looking at (1) the instruments used in tubal insufflation (a bricolage of already existing instruments) and the interaction between doctors and bodies in which they were modified so as to "work", (2) at the processes of communication and knowledge production within the medical

community and (3) at the interaction between doctors and patients. Based on case records from the university hospital of Tübingen, the paper will ask how the demands and expectations of infertility patients contributed to the stabilisation of this new diagnostic method.

Michitake Aso | University at Albany–State University of New York, United States

Y50: a transitional generation of medical doctors in Vietnam

This paper explores the experiences of Vietnamese medical doctors trained during the First Indochina War. This generation, called Y50, studied at the Hanoi Medical University from 1950 to 1957, then located in Tuyên Quang province. Education included field surgery, malaria prevention, and other activities useful for the war effort, as shown by materials held at the Center for the Heritage of Vietnamese Scientists and Intellectuals in Hanoi. Despite the hardships of war, the Y50 generation benefitted from a sense of camaraderie that was essential in the trying circumstances of war. This paper also builds on recent work in medicine and nationalism such as Ming-Cheng Lo's Doctors within borders by showing that a nuanced approach to different generations is necessary to understand how individual Vietnamese medical doctors responded to the question of nationalism. Professors of Y50 such as Ho Duc Di, Dang Van Ngu, and Ton That Tung were trained by the French (and Japanese) and had access to resources necessary to conduct basic research and to earn an international reputation. This did not prevent these medical doctors from choosing to travel to the maquis to fight with the Viet Minh. By contrast, Y50 medical doctors such as Lê Văn Tiến, are less well-known outside of Vietnam as they had little opportunity to publish in international journals. Their lack of fame did not, however, shield this generation from having to negotiate the tension between politics and science and Y50 played an important role in the transmission of knowledge for later medical doctors and researchers in Vietnam.

T176. East Asian medicine

Fri 26 July, 16:00–17:30 • Roscoe 2.2

Chair: Viviane QUIRKE | Oxford Brookes University, United Kingdom

TSUKISAWA Miyoko | Juntendo University, Japan

A changing world and a changing image of the human body: 'bunmei-kaika' and popular body image in mid-nineteenth-century Japan

In 1868, the Japanese medical profession experienced a drastic change accompanying the collapse of the Tokugawa shogunate. The new Meiji government initiated the reconstruction of the basis of medical knowledge from the traditional medicine of east-Asian culture to the modern medicine which was forming in Western culture at that time. Modern medicine, especially detailed anatomical charts, was symbolic of the advanced knowledge of the newly introduced Western culture (the so-called *Bunmei-Kaika*, or civilization enlightenment). Anatomy, as a branch of medical discipline, had reached a highly advanced stage by the second half of the nineteenth century and the Japanese common people at that time could not access the knowledge of human anatomy. During the Edo period, the common Japanese notion of human organs, which were called *Gozo-Roppu*, was that they were scattered inside of the body. This notion was completely dissimilar to that of modern medicine: 'the organs are systematically compacted inside of the human body'. Then, by various means, this information was disseminated among the common people at the beginning of the Meiji-era. In this research project, we analysed a group of cheap prints, called *Jintai-Mondou* (textbooks on questions and answers concerning the human body), which were published in the latter half of the 1870s. *Jintai-*

Mondou had been published as textbooks for the elementary schools, and because of the absence of strict government regulation at the time, they had been freely written and edited by rural intellectuals of various social, educational, and cultural backgrounds. We collected all books titled *Jintai-Mondou*, which were published in the Meiji period and were preserved in Japan. Through the investigation of the process of copying and modifying these books, we were able to consider the alteration process of the image of the inner 'human body'. As a result, we can reconstruct the process of dissemination of the western understanding of the anatomical body to the Japanese common people at the beginning of the Meiji era.

Eunjeong MA | Pohang University of Science and Technology, Korea, Republic of

The herbal pharmaceutical industry in Korea: particularities and universalities over commercialized herbal medicines

This paper addresses a recent history of (re)organization of herbal pharmaceutical industry in South Korea. Since the mid-1990s, the South Korean government has made huge investment in selling Korean Oriental medicine (OM) to the domestic market and the global market. The government either rearranged manufacturing and clinical trial guidelines or newly institutionalized government-subsidized research facilities, whose arrangements were made to turn the local herbal pharmaceutical industry competitive in the global market. In early 2000s, it further established legal foundations to cultivate the OM industry and solicited local pharmaceutical companies to jump into the potentially lucrative herbal market. Incidentally, local pharmaceutical industry underwent restructuring, some of which went bankruptcy. And others, who seemed to have swiftly repackaged and commercialized herbal products as nutritional products, were able to survive and dominate the market. All these government-initiated changes were made possible, as consequences of OM supporters' decades-long fights against the government's indifference, on one hand. On the other hand, OM practitioners have waged a sequence of dispute against Western biomedicine practitioners (including pharmacists) to legitimize their practices in clinical, educational, legal settings. Hence, in this paper I will briefly discuss OM's (re)emergence in the market in historical and political contexts, and move on to the discussion on transnationalizing/globalizing strategies of the herbal pharmaceutical industry, and their consequences.

Kiebok Yi | Seoul National University, Korea, Republic of

Some features of medical knowledge at work: medical practices viewed through medical case records in eighteenth- and nineteenth-century Korea

This presentation attempts to examine some ways medical knowledge was brought into practices, and addresses its implications. Relying not just on categorical medical texts in general but rather on medical case writings, I inquire into how doctors incorporated their practice-based knowledge with text-based theories—with what attitudes doctors mobilized medical knowledge and in what ways they made diagnoses and composed prescriptions—in 18th and 19th century Korea. Exploration of four medical case writings under our investigation leads to the following: Active in the early 18th century, Yi Suki shows that he practiced medicine, while sheltering himself under the veil of antecedents' works, in accordance with the received textbook-based medical knowledge and tried to confirm the efficacy of the age-old medical knowledge. He deployed ready-made-in-the-textbook formulas with minor additions of bencao drugs to adjust the details; Chang Taekyōng, a middle-19th-century doctor, shows that he had great command of the received medical knowledge and utilized the literary and artistic apparatus to present himself to the readers in general; In contrast, Ūn Suryong, in the middle 19th century, reveals the tension between theoretical and empirical knowledge. Drawing a line at the

received textbook-based medical knowledge, especially at the ready-made formulas, Ūn Suryong crafted prescriptions himself without recourse to the received drug formulas in dealing with down-to-earth diseases; Late in the 19th century, Yi Chema, keeping himself at a distance from ancient medical textbooks, manifests his intention to reconfigure or reconstruct East Asian Medicine based on his own recognition of human body and diseases. This distance-keeping attitude toward predecessors' knowledge naturally results in the codifications of new drug formulas to complement East Asian Medicine, completing his own medical system. Not just leaving these features as peculiar instances but putting these cases in the spatiotemporal context, we could say something more: In 18th century, a doctor showed a process in which the received medical knowledge was adapted and internalized in the field of practices, which arguably reflects his being connected to the metropolis-based bureaucratic expertise network; in 19th century, noticeably in the provincial regions away from the official network, some doctors began to make their own ideas and experiences into working knowledge, consequently speaking for themselves.

T177. Images and models in modern medicine

Wed 24 July, 11:10–17:40 • Roscoe 1.008

T177-A. Visual cultures in modern medicine

Wed 24 July, 11:10–12:40 • Roscoe 1.008

Chair: Matthew LANDRUS | University of Oxford, United Kingdom

Maxence GAILLARD | ENS Lyon, France

Transformation in cognitive sciences through the practice of functional brain imaging

The place of neuroscience in cognitive sciences has continuously been increased. From a modest partner of artificial intelligence and cognitive psychology at the beginning of cognitive revolution, it has become the main leader of the field. This "neurocognitive turn" is in fact one of the major paradigm shift in the cognition studies since the birth of cognitive neuroscience (see for inst. Shallice & Cooper 2011).

At the same time many technical progress have been made, that allow us to observe through fundamentally new methods the activity of a human brain. At the turn of the 1990s a couple of imaging techniques were successfully applied to the neural system, like the Positron Emission Tomography or the functional Resonance Magnetic Imaging (Petersen & al 1988, Belliveau & al 1991). Such new techniques of functional brain imaging have had and still have a major impact on the field of cognitive studies, impact sometimes referred to as an "instrumental revolution", in the way the invention of the telescope shaped the post-Galilean astronomy (Posner 1993) – up to the point that contemporary cognitive sciences can barely do without it.

However, those techniques are not exempt from criticism: lively debates take place today between the proponents of imaging and the supporters of alternative methods in cognitive science (Hanson & Bunzl 2010). Unfortunately, little attention has been given to this point by the historians of science, the few reviews on this topic being written by the actors themselves (Raichle 1998).

This presentation will give some insights in the historical background of the emergence and rise of functional brain imaging. Based on the scientific literature published between 1988 and 1995, we intend to show how the technology of fMRI was quickly and widely accepted in the cognitive psychologists community. Our materials are of three kinds: i)

quantitative bibliometric study in the early devoted publications (*Neuroimage* and *Human Brain Mapping*), ii) qualitative study of some papers on specific cognitive science topics (spatial navigation, mental imagery...) and their evolution through this instrumental revolution, iii) institutional life at this critical point (biographies of actors of the field, reshaping of research centers and technology platforms,...).

Beatriz PICHEL | Universidad Autónoma de Madrid, Spain

Knowing the male body: photographic portraits of facial disfigurement during and after the Great War

During the First World War the male body "was intended to be mutilated", as Joanna Bourke has remarked (1996). War provoked death, but also serious injuries and nervous disorders that transformed the bodies of the soldiers, whose limbs were lost or paralyzed. These disabled and mutilated bodies became a medical problem and a social concern, as scholars such as Bourke, Anna Carden-Coyne (2009) and Gabriel Koureas (2007) have discussed. This paper deals with the transformation of the knowledge of the male body operated in this period. It focuses on the impact that medical photographs had in the production and dissemination of that knowledge among civil population in France. In particular, it will examine the medical portraits that showed facial disfigurements and their progressive surgical reconstructions taken in French hospitals, especially in Val de Grâce (Paris). These portraits are interesting for many reasons. They were primarily taken with medical aims, as they allowed the study of the state of the patient and his evolution, as well as the planning of future surgeries. Moreover, these photographs constituted a medical archive of the cases treated, the techniques and the instruments used. But, once the war was over, these portraits entered the public sphere. For example, Doctor Gelly, a French Doctor who treated these patients, the so-called "gueules cassées" ("broken faces"), published illustrated pamphlets in the 20's in order to arise compassion for these men among the French population. On the other hand, Ernst Friederich used these portraits of the broken faces in his pacifist *Krieg dem Kriege!* (1924) in order to denounce the barbarity of war. This paper argues that these photographs questioned the appearance and function of the male body in several ways. They constructed certain ideas about what a male body should be and look like that permeated the social discourses. In this way, this proposal will explore how these portraits travelled from the medical to the social context, and its consequences. Key questions will include the particular impact of photography in the construction of knowledge of the body, and the medical, aesthetics and social problems involved in facial mutilations and disfigurements.

Birgit NEMEC | University of Vienna, Austria

Of social landscapes and political images: visual cultures of anatomy in Vienna, global networks and medico-anatomical artefacts as media of exchange

Anatomists, social policy makers and artists produced in early 20th century Vienna a variety of images of the human body, that not only gained local relevance and international prominence but had different functions, uses and meanings in changing scientific, political and cultural contexts. Various media of anatomical visualization competed, both in the academic spheres of medical and art schools as well as in several places of popular negotiation and production of visual cultures of medicine, such as museums or public health education.

In my talk I want to explore on the intersections of medical-anatomical image production and transformations of knowledge. Around 1900 Vienna housed one of the leading medical schools. Especially because of the production of prestigious anatomical atlases, the Medical Faculty was a magnet for students and scholars from all over the world. The First World War however, not only made anatomical visualisation a difficult and precarious endeavour within limited personal and material resources but rather means of picturing and propagating future humans

and society against the background of key changes in the life sciences, vivid public health debates, aggressive politics and eugenic discourses.

Looking more closely at interwar anatomical image production reveals medical, socio- and biopolitical knowledge in transit. What (epistemic) values determine the specific construction of visual anatomies? What discourses and practices realise actor's assumptions of corporeality, health, sickness and society and what are the contexts that set the stage for the transformations of knowledge, political, social and symbolic orders, related to image production?

On the basis of five key artefacts - an anatomical atlas, a public health chart, a wire brain model, an oil painting and an x-ray film - I will trace exchange processes between national and global visual cultures to elucidate socio-political and scientific orders at work. Working from and with these artefacts, I plan to tell vivid stories about drawing social landscapes (Latour 2007), producing political images (Ranci re 2006), and propagating knowledge about the body. By tracing out these interrelationships, my talk will allow us to take a closer look at urban structures, local milieus and their international networks, thus elucidating, for example, how the first social- democratic anatomical atlas links to hygiene fairs, the global polis and the new visuality of radiokinematography.

Katrin PILZ | Universit  Libre de Bruxelles, Universit t Wien, Belgium

The medical filmmaker: incorporating film knowledge into the medical workspace of the early-twentieth century

In my paper I want to discuss how medical cinematography as new visualisation technique since the end of the 19th century, opened new possibilities in documenting and applying medical methods and practices. Motivated by the rich archive material of knowledge-making medical film sources, I examine the production, application and impact of these film collections in the early 20th century Vienna and Brussels, and will discuss how the incorporation of the cinematograph in medical institutions and operation theatres altered medical methods and enhanced the scientific communication through the new media apparatus. The ambivalent relations between the diverging medical film sources and visual traditions and the academic exchange of medical training, provides optimal conditions to discuss the vehicles of intercultural scientific communication. The research in this field plays an important role between the medical cultures and traditions in both, for the medical-history relevant, German and French-speaking locations. The status and function of film in medical science is depending on the actor-network constellation between the production, distribution and communication and the inter-play of different professional and amateur key-players, such as medical clinics, film institutes, movie directors, medics, technicians, assistants, nurses, patients or unforeseen passers-by.

In the late 19th century, new technical innovations, such as the invention of cinematography, X-ray and the increased use of photography in medical journals and literature, established a new media culture in medicine. The cinematograph and the X-ray instruments displaced former surgical instruments, leading to non-invasive forms of looking. Scientific cinematography has often been seen as accurate evidence of research results, and has seemed to follow explicit visual strategies in medical science. International and intercultural research communities and research spheres have enhanced new opportunities by introducing scientific cinematography as a visual tool to the medical working field. The composite of techniques and representational conventions mark the exceptional position of the genre medical-factual film. The paper analyses medical practice, instruments, and knowledge transfer by investigating the cultural significance of this particular visual genre, the filmic source material allows new perspectives on the application of medical cinematography and possible new gazes in medical visual culture.

T177-B. Models and worldviews

Wed 24 July, 14:10–15:40 ▪ Roscoe 1.008

Chair: Kelley WILDER | De Montfort University, United Kingdom

Lucia DACOME | University of Toronto, Canada

Blinding the midwives: models, tacit knowledge and visual culture in the eighteenth-century midwifery world

In the last decade the history of eighteenth-century anatomical collections has become the object of increasing scholarly interest. Yet, midwifery collections have received comparatively little attention. This paper focuses on the midwifery collection gathered in Bologna by the surgeon Gian Antonio Galli (1708–1782). Galli's collection consisted of an impressive sequence of about two hundred models in wax, clay and glass. Placing three-dimensional anatomical visualisations at the centre of midwifery training, it included specimens of the pelvis, waxworks that displayed the anatomy of the parts of generation, and dozens of models in clay of the gravid uterus presenting the unborn child in a multiplicity of situations. Seeking to unveil pregnancy in all its possible circumstances, Galli's collection promised to provide a means for mapping and clarifying the uncertainties and ambiguities that proverbially characterised the complex domains of generation and pregnancy. It also enacted a special form of midwifery training that presupposed blindfolding the midwives who practised on the models. Defining a multifunctional space of both curiosity and training practice, the collection mediated anatomical knowledge of generation and pregnancy to lay viewers as well as to midwives and medical students. In 1757, it was purchased by pope Benedict XIV, who donated it to the Bolognese Institute of the Sciences. This paper considers the early history of Galli's midwifery collection in light of changing views of the pregnant body and shifting midwifery practices and licensing regulations.

Historians have drawn attention to early modern views of the pregnant body as an ambiguous body whose uncertain signs changed in unforeseeable and potentially deceitful ways. In the mid-eighteenth-century, midwifery collections staged visually impressive material archives of the pregnant body that promised to mark the triumph of anatomical knowledge over the proverbially elusive character of early modern corporealities. This paper reconstructs how models' visualizations of pregnancy participated in shaping views of the female body while, at the same time, re-defining midwives' realms of competence and expertise. It suggests that by spelling out the uncertainties and mysteries of the pregnant body, Galli's collection translated midwifery tacit, gestural knowledge into a demonstrative regime of learning that created new forms of transfer and control of midwifery knowledge.

Anna MAERKER | King's College London, United Kingdom

A 'model factory' at work: anatomical models and social improvement in the nineteenth century

In the 1830s, the French Dr Auzoux founded a factory for the production of anatomical models in his small home-town in Normandy. The models were made from a paper paste which allowed for the construction of robust, 'dissectible' artificial bodies, and for serial production using moulds. Distributed globally, in the nineteenth century the Auzoux models contributed to a range of public education projects, in places such as Egypt, the U.S., and India. However, the models were also part of a project of social improvement at home: the model factory provided education, exercise, and welfare support for its workers. Being instructed in anatomy and physiology, some workers went on to become medical professionals in their own right, and the Auzoux factory was held up by advocates of the French public health movement as a textbook example: a true 'model factory'.

In this paper I investigate practices of improvement at the factory, and

their relationship to model makers' and model users' reflections on the public utility of anatomical models. I also show that ideas about improvement were central to the marketing strategies of the enterprise.

Florian HUBER | University of Vienna, Austria

Embodiments of a scientific worldview: the Blaschka glass models

The presentation will focus on the glass objects fabricated by Leopold and Rudolph Blaschka. Around 1860 to 1936 father and son created thousands of lifelike models of marine invertebrates as decorative items and teaching resources for universities and scientific collections in Europe and the U.S. Their lifelike appearance, delicate details and the fact that they are completely made of glass still exerts fascination today. Their display of organicist aesthetics, clearly visible for example in the jellyfish's relations of symmetry, places the glass models in the context of art nouveau. Aside from this they are also embodiments of a scientific worldview. The Blaschkas knew the relevant literature on marine life and botany, they observed organisms in the field and they corresponded with leading scientists. While they visited aquariums to witness marine animals, set out a garden and Rudolph even undertook a botanical expedition, many of their models were made from drawings. Of special importance in this context were the illustrations of Ernst Haeckel, who was an early patron of the Blaschkas and lent them books from his own library. Models like the glass radiolarians were completely based on the already idealized pictures of Haeckel, as the Blaschkas did usually not work with a microscope. All this points to the assumption that the glass models were not just mimetic copies of nature but that different forms of mimesis, of translation and representation were at play. They not only represent something, they also transform and reshape phenomena and thereby constitute an area that is at least partially autonomous from the phenomena themselves as well as from theories. Science studies and especially Actor-Network-Theory (ANT) have shown that such objects require networks that stabilize them and allow them to circulate as coherent entities. My talk will investigate the complex relationships and circumstances that made the Blaschka models possible. Which role did the different media (paper, glass), the different skills (biological observation, drawing, glassmaking) and the different forms of knowledge (biology, craft knowledge) play in the making of the models? Furthermore, how were the models themselves depicted and described, and in which different contexts did they themselves or representations turn up?

CARRETA Jorge Augusto | University of São Paulo/Facamp, Brazil

A ceroplastia na Faculdade de Medicina de São Paulo: sua importância para a consolidação das especialidades médicas (1930-1950)

A partir da análise do trabalho de Augusto Esteves, responsável pela confecção de peças ceroplásticas para as cátedras de dermatologia e medicina legal da Faculdade de Medicina de São Paulo, entre 1930 e 1950, e da literatura sobre o tema, o objetivo é perceber o papel da modelagem em cera na consolidação de novas especialidades médicas e seu reflexo no ensino dentro da Faculdade de Medicina da Universidade de São Paulo. Adicionalmente, busca-se também elucidar as relações entre medicina clínica e medicina científica e suas consequências para o ensino médico e a formação profissional.

The ceroplastics at the Faculty of Medicine of São Paulo: their importance to the teaching and the consolidation of medical specialties, 1930-1950

From the analysis of the work of Augusto Esteves, responsible for the manufacture of ceroplastics parts of the human body for the chairs of dermatology and forensic medicine at the Faculty of Medicine of São Paulo, between 1930 and 1950, and the literature on the topic, the goal is to understand the role of wax modeling in the consolidation of new medical

specialties and its reflection in teaching within the Faculty of Medicine, University of São Paulo. Additionally, it is also elucidate the relationships between clinical medicine and scientific medicine and its implications for medical education and training in Brazil.

T177-C. Medical techniques and medical knowledge

Wed 24 July, 16:10–17:40 • Roscoe 1.008

Chair: Ian BURNEY | University of Manchester, United Kingdom

Lidia Martha BARAJAS GONZÁLEZ | Universidad Nacional Autónoma de México, Mexico

“El microscopio reveló”: el estudio de los tumores en la medicina mexicana durante el siglo XIX

A mediados del siglo XIX los médicos mexicanos llevaron a cabo estudios histológicos microscópicos de diversos tumores. Con base en dichos análisis produjeron una discusión en la que algunos de ellos muestran ciertas reservas acerca de la utilidad práctica y epistemológica del estudio histológico para el ejercicio de la clínica. En contraste abogan por el diagnóstico y tratamiento temprano de las tumoraciones. Es hasta la última década del siglo, cuando hubo madurado la histología, que algunos médicos hacen una apología del uso del microscopio y la histología para el estudio de piezas anatómicas y el diagnóstico de los tumores. En el presente trabajo propongo que quienes defendieron esta vertiente de la anatomía patológica emplearon este discurso a manera de justificación para fundar un espacio que les permitiera llevar a cabo sus estudios, esto permitió, a su vez, la institucionalización de la práctica histológica y el uso del microscopio, a pesar de que el uso del instrumento en el estudio de los tejidos, en principio no pareció aportar conocimientos nuevos a la ciencia y a la práctica médica cotidiana. Me interesa subrayar que la progresiva institucionalización de la histología microscópica se debió en gran medida a un contexto complejo que involucra discusiones médicas sobre prácticas, conocimientos, instrumentos e intereses grupales.

“The microscope has revealed”: the study of tumors in Mexican medicine at the end of the nineteenth century

In the middle of the nineteenth century, mexican physicians practiced histological studies of different tumors. The histology as a discipline and the use of the microscope produced a discussion about its practical and epistemological uses: some physicians think that microscopes did not have much practical and epistemological value and uses for his clinical and diagnosis practices; they defended the early diagnosis and treatment of tumors, based in the senses. At the end of the century, some physicians did an apology of the microscope and the histology, for the study of pathological pieces and the diagnosis about tumors. In this paper I propose that the physician who defended instrumental practices justify the foundation of an space for his own political interest and work. It allowed the institutionalization of the histology and the growing use of the microscope in Mexico, despite the uses of the instrument in the analysis of tissues at the beginning apparently didn't contribute with new knowledge in science or the medical practice of every day. I am interested in point out that the progressive institutionalization of microscopical histology was in a big extent framed in a complex context that involves medical discussions about practices, knowledge, instruments and group's interests.

Maria Estela JARDIM | Faculty of Science, University of Lisbon, Portugal

Medical diagnosis and photomicrography in the nineteenth to the early-twentieth century

Early attempts to record medical microscopic images by photographic processes were done as soon as the technique was invented.

In 1840, Alfred Donné, free professor at the *Faculté de médecine* in Paris, took some photomicrographies adapting a daguerreotype camera to the microscope. With his assistant the physicist Léon Foucault, Donné published in 1845 a medical course “*Cours de Microscopie*” to be used by his students. An Atlas was also published, accompanying this publication, containing microdaguerreotypes of human fluids and tissues.

Despite this pioneering work it would be another ten years before photomicrography became implemented as a tool in medical research and teaching; questions were still raised on the use of microscopy for medical diagnosis.

The invention of the gelatin-dry plates in 1871 by the physician Richard Maddox, himself a keen microscopist, and improvements on optical equipment and artificial lights, led to an adequate use of photomicrography in medicine; by the end of the 1870s bacteria was being photographed. At the end of the 19th century the microscope had become a fundamental tool in medical research. Atlas, books and papers on the subject of photomicrography were then published and printed using mainly the half-tone process.

In Portugal the physician May Figueira (1829-1913) who studied in Paris, introduced microscopy and photomicrography in 1862 to his students in the Lisbon Medical School. By the end of the 19th century, microscopy was acknowledged in the country as an important tool to study diseases. The Portuguese bacteriologists Ricardo Jorge (1858-1939) and Anibal Bettencourt (1868-1930) made photomicrography a central tool for documenting their medical diagnosis.

In this paper we will discuss the role of the photomicrographic technique in diagnosis and in the illustration of medical scientific publications. Particular emphasis is placed on its impact on the development of bacteriology and histology.

Romarc NOUAT | Université François Rabelais de Tours, France

Naissance et diffusion d'une technique chirurgicale durant la Grande Guerre: la technique d'extraction des corps étrangers des médecins Ledoux-Lebard et Ombredanne

La Grande Guerre reste à ce jour le conflit le plus meurtrier pour l'armée française dont les blessures physiques et psychologiques qu'elle a engendré, ont à jamais marqué les Français. Les blessés déversés sur tout le territoire français ont été pris en charge par des médecins qui ont dû inventer de nouvelles techniques médicales et opératoires pour soigner ces soldats. Parmi ces dernières, l'extraction des corps étrangers est la plus pratiquée dans les régions de l'Intérieur dont fait partie Tours. C'est dans cette ville, au sein de l'hôpital complémentaire n°2 situé au lycée Descartes, que le chirurgien Ombredanne et le radiologue Ledoux-Lebard mettent au point une technique d'extraction de corps étrangers sous le contrôle intermittent de l'écran radioscopique. Technique chirurgicale parmi d'autres durant une période favorable à la recherche, on peut s'interroger sur ses origines et surtout sur sa diffusion sur le territoire français et à l'étranger. La recherche et l'exploitation d'archives iconographiques et écrites, provenant de centres d'archives du Ministère de la Défense, l'étude des ouvrages scientifiques écrits durant et après le conflit, ainsi que celle de l'activité des sociétés médicales et scientifiques de cette période, nous en dévoilent le processus de création et de diffusion. Mise au point à la fin de l'année 1915, elle affiche un taux de réussite proche de 100 %. Présentée à la Société de Chirurgie en novembre 1915, société où se définit la conduite

quirúrgica a tenir durant el conflicte, ella adquireix una renombrada nacional. Ella se difunde també per son ensenyament a des metges francesos i estrangers, i poc a poc, ella és utilitzada per l'ensemble de metges de la 9a regió militar (una divisió militar del territori) de la qual Tours és el cap lloc. Bé que ella permete pràcticament a coup sûr l'extracció de cossos estrangers, l'importància dels mitjans humans i materials que ella necessita, fet que ella n'est principalment emplenada qu'à l'interior. Tema del conflicte i respondint a un necessitat específica generada per des danys massivament provocats per l'artilleria, aquesta tècnica ha conegut una certa renombrada internacional, sa descripció ha estat editada en anglès. A la fi de la guerra, ses creadors retornaren a seus serveis civils, posant així la qüestió de l'utilització d'aquesta tècnica després del conflicte.

T178. Science, medicine, industry and markets

Fri 26 July, 14:10–17:40 • Uni Place 4.205

T178-A. Medicine, science and industry

Fri 26 July, 14:10–15:40 • Uni Place 4.205

Chair: Ross MACFARLANE | Wellcome Library, United Kingdom

Felipe LEÓN OLIVARES | Facultad de Química y Esc. Nac. Prep. UNAM., Mexico

Génesis de la industria de los esteroides en México: las hormonas sexuales

La presente ponencia tiene el propósito de explicar las contribuciones científicas de los Laboratorios de Investigación Syntex en el campo de la síntesis orgánica de hormonas esteroideas entre 1944 y 1956, transformando la diosgenina en progesterona, testosterona, cortisona y anticonceptivos. Por otra parte, también se describen las aportaciones científicas de Russell E. Marker al usar como materia prima vegetal el "barbasco" (*Dioscorea composita*, Hemsl) para obtener la síntesis de hormonas esteroideas, así como la trascendencia de algunos investigadores en Syntex, como George Rosenkranz y Carl Djerassi. Finalmente, también se destaca la formación de químicos mexicanos y la vinculación entre Syntex y el Instituto de Química de la Universidad Nacional Autónoma de México.

La ponencia destaca, la contribución de 1951, en que Djerassi, Miramontes y Rosenkranz perfeccionaron el método de Birch, partiendo de una estrona que habían sintetizado a partir de la diosgenina; de ese modo, obtuvieron la 19-nor-progesterona y con un mejor rendimiento (Djerassi, *et al.*, 1952:1712; Ringold, *et al.*, 1956:2477). En esta investigación Luis E. Miramontes logró la síntesis de la 19-nor-progesterona, una potente hormona progestacional (Miramontes, *et al.*, 1951). Con base en esta metodología experimental sintetizaron compuestos con mayor potencia progestacional como la 19-nor-17- α -etiltestosterona, conocida comercialmente como noretisterona o noretindrona.

La historia de Syntex se desarrolló al amparo de la política económica del Estado mexicano que protegía a la industria nacional y los recursos naturales a través de decretos ejecutivos que aplicaban impuestos prohibitivos a la exportación de las hormonas elaboradas por las otras compañías y negaban los permisos forestales necesarios para colectar y transportar el rizoma del barbasco. Con estas características los Laboratorios de Investigación Syntex fue pionera y líder en la síntesis química a nivel mundial. A mediados la década de los cincuenta Syntex.

Finalmente, el trabajo está fundamentado en una revisión de fuentes primarias en el Archivo General de la Nación, publicaciones científicas y un trabajo de historial oral, en particular con Rosenkranz, Djerassi y Miramontes.

The origin of the steroids industry in Mexico: sex hormones

The aim of this paper is to explain the Syntex Research Laboratories's scientific contributions in the field of the organic synthesis of steroid hormones between 1944 and 1956, transforming diosgenin into progesterone, testosterone, cortisone and contraceptives. On the other hand, this work describes the scientific and technologic contributions Russell E. Marker made. Marker used the Mexican plant as the "barbasco" (*Dioscorea composita*, Hemsl) as raw materials to synthesize steroid hormones, and the transcendence of some Syntex's researchers like George Rosenkranz and Carl Djerassi. Finally, it is important to highlight the mexican chemist formation and the linking between Syntex and the Chemistry Institute of the Mexican National Autonomous Universities.

The paper explains the contribution of Djerassi, Miramontes, and Rosenkranz what perfected Birch's method, using an estrone they had synthesized from diosgenin as their starting point; in this way, they achieved 19-nor-progesterone, with even greater yield. This topic was being studied at several research centers: for instance, in 1953, Wilds and Nelson synthesized 19-nor-testosterone, with greater yield, using estradiol. In that period, the research group at Syntex improved their synthesis of 19-nor-progesterone. Based on this experimental methodology, they synthesized compounds with even greater progestational potency, such as 19-nor-17- α -ethylnitesterone, which is known commercially as norethisterone or norethindrone.

The story of Syntex was part of the development of the steroids industry in Mexico, Syntex developed under the protection of the Mexican government's economic policies, through executive decrees that put prohibitive taxes on the other companies' hormone exports, and denied them the necessary forest permits to collect and transport barbasco rhizome. In this way, Syntex Research Laboratories was pioneer and leader in chemical synthesis, worldwide. In the mid-fifties, Syntex was absorbed by the American company Ogdan Corporation.

This study was conducted using documents from the Nation Historical Archive, scientific journals, as well as interviews with Rosenkranz, Djerassi and Miramontes as reference.

Michael J. LYNKEY | Komazawa University, Japan

Initial inroads into interferon: the earliest commercial development of interferon in Japan

Interferon is any of several types of proteins produced by the body's cells to fight against viral infections and tumours. Although the discovery of interferon in 1957 is linked to the efforts of Isaacs and Lindenmann in the UK, its presence was first observed by Japanese virologists, who serendipitously stumbled on a 'viral inhibitory factor' while attempting to produce a more efficient vaccine for smallpox. They conducted the earliest research on this VIF, but because their work was published in French it did not reach a wide audience. Later, in the 1960s, when pharmaceutical preparations of natural or synthetic interferon became feasible, the world's media heralded the development of this drug, which was thought to be a remedy for all kinds of ills by boosting the body's natural defences to destroy viruses. In particular, interferon was seen as a wonder drug for the treatment of cancer. One of the pioneers in developing this new drug, and the first company in Japan to do so, was

not a conventional pharmaceutical company or a biotechnology start-up firm, but a long-established manufacturing company in the textile business. Toray, a company synonymous with the production of rayon (and, subsequently, nylon and polyester) had recently embarked on a journey to diversify into new strategic industries, and it latched onto the announcement about interferon, which it saw as a means to develop a biotechnology group and produce interferon for the Japanese market. Toray had some modicum of prior experience in the nascent biotechnology business. Shortly after the Second World War, a number of Japanese non-pharmaceutical companies, including Toray, began to synthesise penicillin because of the demand to treat bacterial infections such as septicaemia, syphilis and gonorrhoea. Toray developed deep-tank fermentation as a means to scale-up production of penicillin. Although Toray ceased penicillin production after a few years, because many other companies supplied it, it retained a core group of scientists with knowledge of fundamental techniques who formed the basis of its later efforts in interferon. This paper traces the story of how Toray first became aware of the potential of interferon, why it entered the biotechnology business, and how it developed the first interferon drug for the Japanese market. It benefits from interviews with research scientists and managers in Japan as well as use of secondary data.

Maxine EWANKOW | Antioch University New England, United States

Mexican agriculture, the Green Revolution, and their relationship to the histories of ecology, genetics, and molecular biology

The histories of Mexican agriculture and the Green Revolution provide people, places, and agricultural traditions and innovations through which to explore the reciprocal influence of the early 20th century sciences of molecular biology, genetics, and ecology on agricultural research and practice. The people are Mexican agronomist, ethnobotanist, and "prolífico investigador de la agricultura tradicional," Efraim Hernández Xolocotzi and plant pathologist, geneticist, and Noble Laureate, Norman Borlaug. The places are three valleys in Mexico; Río Yaqui, Toluca, and México.

México is an evolutionary and cultural "center of origin" for maize, magueys, nopal, papaya, tomatillo, and tomato among other foods. Mexican indigenous farmers developed farming systems appropriate to their environments including milpas, chinampas, and acequias. Hernández Xolocotzi documented the indigenous traditional farmers' cultivation of Mexico's food biodiversity and applied their knowledge to his understanding of agroecosystems.

Mexico is also the birthplace to the Green Revolution. By shuttling between the valleys, Borlaug first bred the Green Revolution's high yielding cultivars of wheat, developed through shuttle breeding, while working for the the Programa Cooperativo de Agricultura, a collaboration between the Mexican government and the Rockefeller Foundation. Borlaug's wheat, together with maize and rice, accelerated the modernization of agriculture and substantially increased the agricultural yields of cereals through the application of molecular biology and genetics principles to plant breeding.

Ultimately, this historical narrative focuses on scales of knowledge; from the landscapes of ecology to the minutia of molecular biology and plant genetics; from centuries of honing agricultural practices to the compressed cycles of shuttle breeding. Indigenous agricultural knowledge rooted in time and place and modern agricultural knowledge rooted in the molecular sciences and ecology are evaluated with respect to their contributions to our understanding of the complexities of biochemical-environmental relations.

The juxtaposition of indigenous farming practices and the Oficina de Estudios Especiales within Mexico's valleys and works of Hernández Xolocotzi and Borlaug provide a frame within which we may better assess current science-based claims concerning increasing and

securing our food supplies while maintaining the environmental integrity and sustainability of lands and waters.

Karen Ross | Troy University, United States

Creating 'certain knowledge': developing the anti-meningitis serum and the reform of therapeutic research

The 1904 pandemic of bacterial meningitis challenged scientists in Europe and North America to apply the methods of bacteriology and immunology to therapeutic research. This very public emergency was a chance for advocates of scientific medicine to demonstrate the value of laboratory-based experimental research. In only three years researchers in the United States and Germany began testing anti-meningitis sera on human subjects. It would take another decade to conclusively establish the efficacy of this treatment which reduced mortality from 80 to 20%.

In this paper, I evaluate the development of Simon Flexner's anti-meningitis serum at the Rockefeller Institute for Medical Research. How Flexner produced his serum, determined its efficacy in animals, and then transferred this knowledge to human subjects, demonstrates the evolving standards of scientific medicine at the bench and in the clinic. The outlines of what was meant by scientific medicine were clear to the laboratory-oriented reformers of the period: medical research that sought to replace the perceived failings of clinical observation with rigorous experimental design. However, no precise definition of what was meant by *scientific* existed. The first part of Flexner's meningitis research, based on animal models, illustrates the evolution of Flexner's standards of practice at the bench and his early attempts to define the significance of his data. Flexner's characterization of the German serum programs as empirical is revealing of how Flexner himself was coming to grips with these standards.

Part two of Flexner's research, testing the serum's efficacy in humans, sheds light on the history of clinical trials and Flexner's struggles to adapt his methods and standards to the clinic. Flexner assembled dozens of physicians to conduct what was arguably one of the largest clinical trials before the influenza vaccine trials of 1918-19. Over six years, more than 1300 patients received the Flexner serum in ten countries. In the *Progress of Experiment* Harry Marks argued that similar cooperative trials from the 1920s seldom resulted in definitive changes to therapies due to the inherent difficulties of conducting large trials with multiple participants. However, the success of the anti-meningitis serum trial demonstrates that in at least this instance Flexner was able to overcome these obstacles due to the authority and resources of the Rockefeller Institute.

T178-B. Medical markets

Fri 26 July, 16:10–17:40 • Uni Place 4.205

Chair: Bernard LIGHTMAN | York University, Canada

Mat SAVELLI | Chemical Heritage Foundation, United States

Pushing pills and selling psychiatry: psychopharmaceutical advertisements in an international context, 1953-1993

In the post WWII period, psychiatry has undergone a series of tremendous shifts which have fundamentally altered the profession's scope, identity, and claim to medical legitimacy. Key among these changes has been the dramatic rise of psychopharmaceutical drugs. Originally an adjunct thought to facilitate the establishment of a therapeutic relationship between patient and practitioner, psychopharmaceuticals have firmly ensconced themselves as the frontline treatment for mental illness in its severest and mildest forms. Alongside the growth of pharmaceutical treatment, psychiatry has been reshaped by changes in diagnostic criteria and a growing international consensus on what exactly qualifies as mental illness. Local and culturally-specific notions of disorder and its aetiology have been

displaced by the universal language of biochemistry and the epidemiology of mental illness in the various corners of the globe is beginning to look increasingly homogenous.

This paper addresses these dual processes - the supposed "pharmaceuticalization" and "globalization" of mental illness – through the lens of advertising. Pharmaceutical advertising has recently figured into the thinking of historians such as Jonathan Metzl, Jeremy Greene, David Herzberg, and others, yet work on the subject has largely been confined to the United States. This paper introduces an international comparative element by examining print advertisements in eight countries (Argentina, USA, UK, France, Croatia [Yugoslavia], Tunisia, India, and New Zealand) in the period 1953 – 1993. Analysing advertisements in general and specialist journals, the paper discusses the extent to which the increasing profile of pharmaceutical medications can be linked with the growing international confluence of key concepts regarding the cause, experience, and treatment of mental illness. Moreover, it considers how advertisers confronted the challenges of shifting political and socio-cultural climates in these diverse medical markets. The paper concludes by arguing that, while ostensibly selling a product, these advertisements are perhaps more significant for their abilities to sell ideas.

Maria CORREA | Universidad Andrés Bello, Chile

Electricity and the medical market: the Sanden Electric Company and the ‘commodification of nerves therapeutic’ in Santiago de Chile, 1900-1910

In the early 1900s the Sanden Electric Company, an American successful business, started to promote in Santiago de Chile a wide range of electric devices that promised to strengthen and to invigorate the exhausted nervous system. Through aggressive marketing tactics - such as the publication of small booklets and testimonial letters - Sanden electrotherapeutic company articulated an influential discourse that permeated the urban landscape and contributed to the spread of medical ideas from the experts to the lay public. This discourse not only allows as scrutinizing the role played by hundreds of objects -part of a growing therapeutic trade - within early twentieth medical culture, but also points to the influence of new technologies and sciences (such as chemistry, electricity and biology) in the medical market and therefore in the development of Chilean medicine. This paper is part of a postdoctoral research on consumer society, therapeutics and mental disorders in Chile between 1850 and 1930. On the one hand, it problematizes the role of academy and governmental institutions, such as the university and the madhouse, in the shaping of medical ideas on mental and nerves disorders. On the other, it places the market and the process of commodification of health care as central pieces in the development of new sciences and technologies that influenced Chilean medicine.

Michelle WALLIS | University of Cambridge, United Kingdom

Publicity and practice: handbill advertisements and the ‘medical marketplace’ in England, 1660-1720

Our understanding of medical practice in early modern England has for some time been shaped by the poorly-characterised concept of the ‘medical marketplace’. But what was the ‘medical marketplace’? How far did it extend beyond the urbanity of London? Who traded within it? And what was being bought and sold? The British Library is home to three collections of rare medical advertisements dating from around 1660 to 1720, most of which take the form of handbills; these unique sources allow us to sketch a fresh picture of the ‘medical marketplace’ of this period, including the rise of the patent medicines that would become increasingly prominent over the course of the eighteenth century. They also allow us to consider how the practitioners and vendors of medical goods that traded within that marketplace, from university trained physicians to producers of single nostrums, presented themselves to potential customers, and give insights into how the medical market was

structured, and what issues were contested by its participants. Integral to trade within any market is the credibility of the vendor, or in this case, the practitioner or dispenser. This paper will investigate some of the ways in which practitioners and nostrum-peddlers made use of the burgeoning medium of cheap print to cement their authority and bolster their reputations as legitimate practitioners in the reading eyes of their potential customers. This struggle to secure a popular reputation, and thus, a toehold in a highly competitive (and profitable) market, is framed against the background of contemporary struggles between the College of Physicians, the Society of Apothecaries and other institutions to assert their right to regulate medical practice and the sale of drugs in this brief

Ross MACFARLANE | Wellcome Library, United Kingdom

Druids, drugs and diaries: the trade literature of Burroughs Wellcome & Co

One hundred years after the opening of his Historical Medical Museum, Henry Wellcome has never been more recognised, both as a voracious collector and pharmaceutical entrepreneur, than he is today. Wellcome, however, pronounced during his lifetime that his business and collection should remain separate concerns. Despite this aim, these two dominating areas of his life do intermingle in the pages of the trade literature produced by his company, Burroughs Wellcome & Co. This paper will show that a close reading of these materials – such as diaries aimed at medical professionals and specially produced localised publications for conferences of the British Medical Association - illustrate not only Wellcome’s methods in promoting the full range of his products (from compressed medicines to photographic developers) but also a system of understanding medicine’s past that encompassed non-western traditions.

T179. Bio/medical practices

Single session. Fri 26 July, early afternoon ▪ Uni Place 3.205

Chair: James POSKETT | University of Cambridge, United Kingdom

Alison ADAM | Sheffield Hallam University, United Kingdom

Romantic moments for bacteriologists: life, death and bacteriology in Tutankhamun’s tomb

‘Even in the life of a bacteriologist there are romantic moments.’ Such were the words of Henry Bunker, assistant bacteriologist to the UK’s Royal Naval Cordite Factory, in 1925. The romantic moments centred on his barely concealed excitement at the arrival of six tubes of dust collected from Tutankhamun’s inner tomb by Alfred Lucas, Chemist to the Egyptian Antiquities Department, immediately upon the chamber’s first official opening in 1923.

All the tubes were sterile, save one which contained two micro-organisms. Proof that that bacteria had survived thousands of years in the tomb? No. If bacteria had survived in the tomb, presumably the tubes would have contained millions of them. The single mould spore and the micrococcus must have been blown in upon the draft when the tomb was opened. If bacteria could not survive, Bunker concluded, it was most unlikely that any seeds found in the tomb would still be capable of germination. The results of this little experiment, therefore, appeared to hammer another nail into the coffin of the ‘mummy wheat’ myth. So, had Bunker debunked ‘mummy wheat’? Apparently not. The ‘mummy wheat’ myth had been in circulation for at least a century before and belief in the myth of ‘mummy wheat, capable of germination persisted years after the opening of the Tutankhamun tomb.

In any case, Lucas must have known that his experiment was far from conclusive on several counts, at last partly because excavation sponsor, Lord Caernarvon, his daughter, Lady Evelyn, and archaeologist, Howard

Carter, had secretly entered the inner chamber shortly after its discovery in November, 1922. Given that the chamber would not have been sterile after the November 1922 entry, Lucas must have known that his experiment could well have yielded quite a different result.

Ironically, one explanation, still entertained although controversial, for the death of Lord Caernarvon weeks after the inner chamber's official opening, relates to the possibility that he succumbed to Aspergillosis caused by fungi harboured by the wheat which was present in the tomb. In other words, living things, potentially in the tomb, were enrolled into providing a purportedly scientific explanation for the 'Mummy's Curse'. Lucas' experiment made little difference to the circulation of such myths. Mummy wheat, the Mummy's curse and microscopic organisms (ancient or modern) seem destined to be inextricably, if ambiguously, linked to provide yet more romantic moments for bacteriologists.

Svitlana RUDA | Kyiv Institute of Culture and Art Design, Ukraine

White flower against the 'white plague'

In one of his public lectures in Odessa in 1888 Ilija Mechnikov stated that 1/5 of all the deaths on Earth is caused by tuberculosis. And although the agent of this cruel disease has been discovered in 1882 by Robert Koch, it continues to deprive prematurely the mankind of the people, among them such remarkable ones as Spinoza, Chopin, Belinsky, Nadson etc.

TB disease or the White plague is known from the ancient times. Examination of the remains of primitive man and the ancient Egyptian mummies has revealed that their bones bear the traces of tuberculosis. In Mesopotamia Code of the King Hammurabi stated the right to divorce your wife, if she had TB. Hippocrates was writing about the spread of tuberculosis in Ancient Greece. The consequences of tuberculosis were registered in the study of human skeletons from the graves of the Medieval Kyiv.

International League of Fighting with Tuberculosis was organized at the threshold of the 20th century. Cross of Lorraine was adopted as a symbol of anti-tuberculosis movement in 1902 – the red cross with two horizontal stripes. Soon after that White Flower day was established in Switzerland. On the 1st of May, 1908 the young men and women were selling white flowers on the streets of Geneva, proceeds from which were transferred to the Anti-Tuberculosis Fund. This custom had been adopted in other countries of Northern and Western Europe and then in Russia.

In the beginning of the 20th century Russia occupied the first place among the European countries in the mortality of the population from tuberculosis. All-Russian League against tuberculosis had started its activities in 1910. In April 1911 League had organized the White Flower days, the symbol of which became the Daisy. Saint-Petersburg, Moscow, Minsk, Riga, Kyiv, Kharkov, Odessa and many other cities of the Russian Empire had participated in this activity. In Yalta among the white flower sellers were the members of the Romanov House – tsarevich Alexei and his four sisters. The annual celebrations of the White Flower day had been stopped in Russia after the October revolution.

At present tuberculosis remains one of the most common diseases: according to the statistics 1/3 of mankind is infected with its germs. In the post-Soviet space this disease, which was considered endangered, acquired epidemic form. And 100 years later after its first creation the tradition of the White flower day is back in the countries of CIS (Russia, Belarus, Ukraine).

Mónica BALLTONDRE PLA | Universitat Autònoma de Barcelona, Spain

Parapsychological practice in Spain: local characteristics and epistemological implications

Spain is historically considered to be mainly a catholic country, showing some efforts in getting involved in scientific enquiry. In such a context we may not expect parapsychology to root. Nevertheless, the formation of spiritualist (or sometimes also called "spiritist") associations expanded towards the end of the nineteenth century, and psychical research in form of "metapsychique" attracted some public attention, especially in the 20ies and 30ies in cities like Madrid or Barcelona.

Until now we only have a few historical contributions on the history of spiritualism and even less on the history of psychical research in Spain. Our contribution will document the presence of psychical research in Spanish society during the first decades of the 20th century. A revision of the news in the daily press helped to obtain information about the activities that were taking place. A broader documental research was instrumental in identifying several new historical actors, involved in the debate about psychical research.

Paranormal phenomena produced in spiritualist séances were able to involve some scientists, like the astronomer Comas who in his examinations and explanations during the first decade of the twentieth century followed the example of French scholars like Flammarion. At the same time, and inspired by the theories of Janet, the physician Victor Melcior i Farré diagnosed and cured the "psychical doubling" of a young woman, presenting symptoms related to mediumship and spiritualist activity. Soon after, in the twenties, the treatise on metapsychique of Richet achieved great influence, provoking a harsh dispute among physicians. These debates, together with the metapsychical experiments undertaken by the Marquis Santa Cara and the pharmacologist Josep Poch, illustrate how psychical research became a widespread practice at that time in Spanish cities like Madrid and Barcelona, despite the attempts of a Jesuit psychologist to stop this movement.

In the present paper I use some examples of psychical practice to reflect on a) the relations between spiritualism and parapsychology (or metapsychics), b) the specific possibilities and constrains of the social context of Spain at the time, and c) the epistemological implications of the debates with regard to empirical proof and scientific method.

Sabrina PÁSCOLI RODRIGUES | Pontifícia Universidade Católica de São Paulo, Brazil

Maria Helena ROXO BELTRAN | Pontifícia Universidade Católica de São Paulo, Brazil

The microorganism in Pasteur's work: a study on fermentation, silkworm disease and rabies

The chemist Louis Pasteur (1822-1895) devoted himself to studies as crystallography, fermentation, spontaneous generation, silkworms' disease, rabies, avian cholera, anthrax, among others. In many of these works, we see the microorganism as the protagonist. However, the design of the action and the nature of these microorganisms are different in the cases covered in this study. At the beginning of his work on fermentation, Pasteur refers to this process as a "mysterious phenomenon" and through his research he relates the microorganism to the fermentation. Pasteur related this phenomenon to medical applications, whereas fermentation and disease were similar procedures. In the early nineteenth century evidence emerged that diseases could be caused by microscopic parasites. Before that, the microorganisms were observed in sick organisms but they were initially considered as a consequence of the disease rather than its cause, as happened in the studies of Pasteur on the silkworm disease, the first disease studied by him, in 1865. Initial work of Pasteur on microbiology was related to the parasitological nature of the pebrine, in which he noted the existence of microscopic corpuscles in the body of sick caterpillars. During research on the silkworm, the presence of the microorganism in sick caterpillars was not related to the disease. Later, Pasteur devoted himself to studies about rabies. In this case the microorganism appears, within the concepts of Pasteur, as the causative agent of the disease. This research was of great importance for the development of the germ theory of disease in the latter half of the

nineteenth century. The objective of this paper is to discuss these different conceptions about the microorganisms that are present in the work of Pasteur, and analyze the factors that led to several changes in conceptions about the nature of microorganisms related diseases, their prophylaxis and to the development of vaccines. This research is part of larger projects developed by the CESIMA, with support from CAPES (PhD scholarship).

T180. Scientific expeditions, travels and colonialism

Sat 27 July, 09:00–12:30 ▪ Uni Place 3.204

T180-A. Colonial expeditions

Sat 27 July, 09:00–10:30 ▪ Uni Place 3.204

Chair: Roderick HOME | University of Melbourne, Australia

Chaisung LIM | the Institute for Japanese Studies, Seoul National University, Korea, Republic of

The health and disease of workers in colonial Korea, 1910-1945: the labor hygiene of the Korean National Posts and Telecommunications (KNPT)

The task of the present study is to elucidate the reality of labor hygiene in Colonial Korea by reviewing the employees' health conditions in the Korean National Posts and Telecommunications (KNPT) and the KNPT authorities' measures taken against it. A colonial employment structure, which emphasized the role of ethnic Japanese in the division of labor system, was built in to the KNPT. Ethnic Koreans were assigned mainly to the lower classes of the hierarchical system and relatively to dangerous tasks with the wages amounted to only more than half of those of the Japanese. Nevertheless, the health indexes, e.g. morbidity rate, death rate and turnover rate from diseases of the Koreans were lower than those of the Japanese, which means that the physical conditions of Koreans were better than those of Japanese. Even though Japanese employees often worked indoors and lived communally after work, the very comfortable life style was the cause that increased the likelihood of their exposure to infectious diseases. To cope with these situations, KNPT authorized established the Field Worker Relief Association and strengthen the part-time doctor system. However, while the morbidity rate showed an upward trend from the mid-1930s, the mortality rate and the disease turnover rate were not high. 'The good body-making policy' of KNPT authorized was not to decrease the diseases but to hold down the deaths and retires concomitant with the increase of diseases.

Jan VANDERSMISSEN | Université de Liège, Belgium

Lalande on Africa: science policies in late eighteenth-century France and the renewed interest in a scientific investigation of the continent's interior

In his *Mémoire sur l'intérieur de l'Afrique* (An III de la République, 1795) the influential French scholar Joseph Jérôme Lefrançois de Lalande (1732-1807) outlines the goals of a project which directly links scientific exploration to the needs of the State, urging both men of learning and state officials to work closely together in the organization of research missions that enhance man's knowledge of the geography, natural history and commerce of Africa's yet unknown inner regions – in particular the vast area between Senegal and the Sudan.

This paper analyzes Lalande's aims, arguments and claims against the background of scientific, commercial, political and military tensions between France and Britain. It situates Lalande's discourse within the broader context of the competing "science policies" of both states in the

second half of the eighteenth century. The notion of "science policy" as a working hypothesis refers to the way a government applies the knowledge and expertise provided by the scientific world according to the needs of the country.

It is an investigation of the sudden re-emergence of Africa as an object of knowledge in the relationship between power and science. The paper focuses on the continuous interaction between France and Britain in African affairs, and highlights the shift from a mere "enlightened" exploration from the 1720s to the 1780s – a period which saw, on the one hand, the progressive integration of useful knowledge gathered by explorers in African coastal regions into the French "colonial" system, and, on the other hand, the installation of an informal structure of knowledge transfer at the British side – towards Lalande's revolutionary time – the 1790s – when Africa became the subject of a "Banksian" takeover, enhancing British interest in the "unknown" interior of the African continent by setting up large-scale, interrelated research missions with practical goals (the expeditions organized by the *African Association*, e.g. Mungo Park), but also provoking reactions from the French side, a reflection of which can be found in Lalande's dissertation, thus stimulating a new wave of French initiatives in the field.

Tatiana FEKLOVA | Sain-Petersburg branch of the Institute for the History of science and Technology, Russia

The financing of expeditions of the Imperial Academy of Science in St Petersburg during the first half of the nineteenth century

The organization of any expedition for the Imperial Academy of Science was a complex process from both a scientific and administrative point of view. Long-term expeditions demanded many months (sometimes several years) of preparatory work that included, among others issues, the obtaining of permit documents and the necessary funding. The expenses of the expedition of the Academy of Science included funds for travel, for salary, for food, to purchase the equipment and collections as well as for "unforeseen expenditures". The government had a flexible approach to financing the expeditions and scientists could bring money (such as banknotes, silver ingot, silver rubles or gold doubloons) or get money from the Treasuries in the remote provinces. An analysis of the expeditions' budget gives us the possibility to better understand scientists' everyday life and work on the expedition and also in St. Petersburg during the preparatory stages. In my paper I'm going to demonstrate the main expense items for the "average" expedition in the first half of 19th century. The examples I will discuss include the budgets of well-known expeditions such as the ones made by K.M. von Baer (1837), A.F. Middendorf (1842-45) and some others.

T180-B. Eighteenth- and nineteenth-century colonialism and travel

Sat 27 July, 11:00–12:30 ▪ Uni Place 3.204

Chair: John DIEMER | University of North Carolina at Charlotte, United States

Rajesh KOCHHAR | Indian Institute of Science Education and Research Mohali, India

The making of scientific, industrial and arrogant Europe

In their eighteenth century encounters with India and the east in general, the British displayed genuine interest in, respect for, and desire to benefit and profit from traditional empirical technologies. Dyeing and printing of cotton textiles using natural materials, zinc metallurgy, steel (wootz) making, and variolation are examples of the bases on which European initiatives were built. There is a persistent pattern in Britain's scientific and industrial discoveries of the early nineteenth century. Once a milestone was reached, details of the steps leading to it were obliterated. Eastern antecedents of scientific discoveries were ignored or

belittled and modern science presented as a stand-alone, without any pre-history. In 1837 a Bengal cavalry officer after an exploratory tour of Egypt and Arabia in connection with steam navigation declared: 'It seems to be a law of nature that the civilized nations should conquer and possess the countries in a state of barbarianism and by such means, however unjustifiable it may appear at first, extend the blessings of knowledge, industry and commerce among people hitherto sunk in the most gloomy depths of superstitious ignorance' The use of the phrase 'law of nature' in the context of human affairs is significant. It is as if the authorship of the powerful knowledge system of modern science bestowed such cultural and racial superiority on the Europeans as to give them a divine right to rule over others. This was also the time when British India decided to terminate its continuity with the Mughal administration, stopped uncritical support for oriental learning, jettisoned Persian as the official language and embarked on English-alone language policy.

Niklas JENSEN | University of Copenhagen, Denmark

Making it in Tranquebar: science, medicine and the circulation of knowledge in the Danish-Halle Mission around 1732-43

From their arrival in the Danish-Norwegian colony of Tranquebar in South India at the beginning of the eighteenth century the missionaries of the protestant Danish-Halle mission were engaging with many different kinds of knowledge present in Tamil society. This paper will focus on the activities in the field of natural knowledge or 'science,' especially medicine and botany, from the time of the arrival of the mission doctor Samuel Benjamin Cnoll in 1732. As a case study, it presents a window into the complex connections between medicine, science, religion and economy in the early eighteenth century, both locally in colonial South India and in global networks. The case shows how the mission in Tranquebar was a 'node' in the circulation of knowledge in such a global network. As part of the circulation process, new scientific knowledge about the colonial 'periphery' of India was constructed in a contingent local fusion of knowledge negotiated with Tamil 'experts' and the concerns of the scientific 'centres' of Europe. In this way, the new scientific knowledge about Indian nature was not just collected locally; it was made in a complex global process.

Pascal PIROT | University of Liège, Belgium

Science and the Belgian dynasty during the reign of Albert I

The paper consists in investigating the role of the Belgian dynasty in scientific development during the reign of Albert I, third King of the Belgians (1909-1934). The study deals with the action of the sovereign and the networks he formed with his entourage (the queen, the crown prince, the advisers of the court, some close relations of the King, the ministers in charge of scientific affairs) and the role of the King's House (Grand Maréchal, Civil List, Cabinet, Military Household) in the field of science, along various topics; how these people saw the role of science in society; what influence they had in the development of science (institutions, initiatives, projects); what relationships existed between the dynasty and the scientific institutions. We would like to consider in particular the relationships between the Belgian Dynasty and the Congo were in the realm of science, through the King's colonial policy, similarities and differences between Albert I and his predecessor Leopold II. This perspective should make it possible to assess the development and progressive implementation of an original "science policy" made by the King, especially in the Belgian Congo.

Numerous archive funds have been used to conduct this study, such as the Archives of the Royal Palace, the General State Archives, the National Fund for Scientific Research (FNRS), the Royal Museum for Central Africa (RMCA) and Belgian scientific institutions. This contribution is presented as part of a doctoral thesis that began at the University of Liège in October 2011, which is devoted to the relations between Science and Dynasty since Albert I until the beginning of King

Baldwin's reign and the publication, in 1959, of the work of the "National Commission of Science" presided by Léopold III, who abdicated several years earlier.

T181. Cultures of eighteenth- and nineteenth-century science and engineering

Mon 22 July, 11:10–17:40 ▪ Uni Place 4.205

T181-A. Cultures of knowledge and practice

Mon 22 July, 11:10–12:40 ▪ Uni Place 4.205

Chair: Geoffrey CANTOR | University of Leeds, United Kingdom

Patrick NOTT | Retired, United Kingdom

John Milne - knowledge exchange: professional amateur

John Milne: Father of Modern Seismology (1850-1913), a great communicator and polymath, returned to the Isle of Wight after nearly twenty years in Japan 1895 with his pioneering seismological knowledge and instruments. Settling in a small rural hamlet he established and ran an new observatory and laboratory with little outside support by mutually exchanging his knowledge and enthusiasm with those of interested locals whose specialist skills he required - they included a local builder, printer, mathematician, tradesman and linguist. They all started with no seimological knowledge but John Milne was so successful as a communicator that after his death these amateurs ran the observatory with little assistance for another six years.

Frank JAMES | Royal Institution, United Kingdom

Humphry Davy at work

The career trajectory of Humphry Davy (1778-1829) was spectacular. He moved from being the son of a bankrupt woodcarver in Penzance to the pinnacle of London metropolitan science as President of the Royal Society in the 1820s. From immediately after his death to the present, biographers and historians who wrote about Davy have struggled to make sense of him as his character presented so many features, some apparently contradictory: philosopher, chemist, geologist, lecturer, poet, applied scientist, snob, social climber, and ultimate failure among many others. In part these characterisations arose from imposing modern categories on him, so, as a start at reinterpreting his life and career, this talk will locate Davy firmly in various workplaces rather than just in the laboratory and lecture theatre of the Royal Institution. Sites where Davy worked included the hospital, the tanning yard, the farm, the prison, coal mines, archaeological museums and the dockyard. In all of these, Davy was either ordered or invited to provide chemical understanding of the materials and processes involved. Indeed the only chemical research that Davy seems to have conducted entirely on his own account was his electro-chemistry. Despite being involved in a variety of working environments, Davy held strongly to the belief that what would work in the specialised and controlled space of the laboratory would necessarily function in the outside world – a belief that on more than one occasion led him to disaster. Furthermore, Davy viewed himself primarily as a philosopher, but the overwhelming evidence is that he spent the vast majority of his time undertaking science with a practical aim, which he sought, with some success, to turn to philosophical account. It was this very success in projecting this disjunction about himself which, it will be argued, contributed significantly to the development of the contradictory historical literature about Davy, a state of confusion which begins to

disappear if one studies what Davy did, rather than what he and others said he did.

Edward DAVIS | University of Cambridge, United Kingdom

The legacy of Lord Rayleigh

The legacy of the Third Baron Rayleigh (John William Strutt) is reflected in the association of his name with the Rayleigh distribution, the Rayleigh-Jeans law, Rayleigh scattering, the Rayleigh disc, Rayleigh waves, the Rayleigh criterion, the Rayleigh number, the Rayleigh-Taylor instability, the Rayleigh-Plesset equation, to mention just a few of his achievements. In addition, he was awarded the Nobel Prize in 1904 for the discovery of argon. The knowledge he gave to the world is still at work today in the design of optical instruments and antennae, in surface acoustic wave (SAW) devices, in seismology, in acoustics, and in studies of convection in fluids, atmospheric turbulence, ink-jet technology and solitary waves. His mathematical methods, developed principally to describe wave motion, are frequently used today by quantum theorists. The private laboratories developed and used by Lord Rayleigh are still extant at the family seat and provide a wonderful and unique insight into the life and work of this great Victorian scientist. Photographs of the laboratories and equipment contained therein will provide the background for a presentation on some of his contributions to science and their ongoing importance.

Manabu KOBAYASHI | Chiba Institute of Technology, Japan

Davies Gilbert's theory of heat and steam: the diffusion of scientific knowledge among scientists and engineers

Davies Gilbert (1763–1833) was one of the most notable figures and an important member of the Cornish scientific community, and had aided Jonathan Homblower (1753–1815), Richard Trevithick (1771–1833), Arthur Woolf (1766–1837), and Humphry Davy (1778–1829). Since they corresponded a great deal, many historians of science and technology believe Gilbert to be a patron of Cornish engineers.

In 2011, Philip M. Hosken published a book, *The Oblivion of Trevithick*. Hosken argues that Gilbert did not support Trevithick's work financially. Gilbert also avoided using Trevithick's name when he 'refers to the development of the steam engine in lectures and letters'. Although Hosken remarks on their personal relationship, he does not pay proper attention to their theories of heat and steam.

Davis Baird and David Philip Miller revealed James Watt was not only engineer but also natural philosopher. Watt (1736–1819) believed that heat was caloric by nature. Baird said, 'elasticity was understood to come from combination of heat—understood as a substance—and water, which together produce the "compound" steam. Watt believed that the pressure in the cylinder affected the ability of the latent and sensible heats in the steam to produce motive power'. At that time, the caloric theory was the most popular theory of heat.

Davy and Count Rumford (1753–1814) had conducted experiments that converted friction into heat. Count Rumford's article, 'An Inquiry Concerning the Source of the Heat which is Excited by Friction', was published in *Philosophical Transactions* in January 1798. Davy's article included an experiment that converted friction into heat, 'Essay on Heat, Light and the Combinations of Light', was published in 1799, but an original manuscript of Davy's article preserved at Royal Institution of Cornwall was dated in June 1798. Davies Gilbert knew experiments of Davy and Count Rumford in 1798.

Trevithick made water-pressure engine in Cornwall in 1798. He got the idea for high-pressure steam engines during his time operating high-pressure water engines, and Gilbert encouraged him to invent it. It was possible to adopt the caloric theory to formulate a theory for high-pressure steam engines.

I will discuss Davies Gilbert's theoretical knowledge of heat and steam and the way scientific knowledge spread among scientists and engineers.

This work was supported by MEXT KAKENHI Grant Number 60447555.

T181-B. The machine

Mon 22 July, 14:10–15:40 • Uni Place 4.205

Chair: Patrick NOTT | Retired, United Kingdom

Amy Bix | Iowa State University, United States

Knowledge and imagination in the history of machine design: from Manchester reality to steampunk style

Today's steampunk writers, artists, and crafters adore translating 19th-century machine knowledge to create designs for modernized dirigibles, fantastic steam-powered weaponry, and even Victorianized laptop computers. Steampunk literature, film, and art offer excellent perspective on the history of technological design, both real and ideal. What did/should our machinery look like? What shapes our machines and context of technological choice? What values does technological design reflect and/or impose? Victorians wrestled with the challenge of inventing an iconography of appearance for steam engines, locomotives, and factories, without converging on consensus. The modern Steampunk movement has created its own visual language of mechanization, extrapolating both from actual Victorian technology and classic science-fiction (H.G. Wells, Jules Verne). Steampunk's pseudo-celebration of 19th-century machine style engages basic questions about design: what is aesthetically attractive, socially relevant, and/or functionally appropriate? My research traces how technological aesthetics moved from Manchester's Industrial Revolution reality to Steampunk fiction, illuminating how, when, and why ideas about machine style evolved. Early 20th-century industrial designers such as Raymond Loewy defined "the modern" by streamlining, while electrification, chemistry, and mass production promised to generate magical abundance. Steampunk reacts against that history, relishing the roughness and romance of solid metal as more honest than plastic's prefabricated pseudo-perfection and environmental toll. Electricity's mystery has been evaporated by ubiquity, restoring retro-allure to its dramatic opposite, the sheer physicality, noise, novelty, and even dangers of steam. At its best, steampunk captures David Nye's "technological sublime," seen in the 1851 Crystal Palace, Manchester's scale of power, and Philadelphia's 1876 Centennial Exposition. Infusing Victorian-style technology with 21st-century sensibilities, steampunk also links to 1970s "appropriate technology" and computer-liberation movements, the ethic of technology by and for the people, freed from corporate marketing monopoly. Intellectually, steampunk can represent a useful corrective to technological determinism, providing insight into the roles of human choice and social context in shaping ideas about machine function, machine design, and mentalities of modernization.

Alice REININGER | University of Applied Arts Vienna, Austria

Wolfgang von Kempelen's steam engine and reaction engine

On July 16th, 1788, Wolfgang von Kempelen sent a letter of request to the Emperor Joseph II. In it he informed the monarch of his development of a fire, or to be more precise, a steam engine, and a second machine which functioned according to the reaction principle. He had reached the point where he was able to demonstrate the machines before a state commission who could examine them in order to grant preferential rights to the Austrian monarchy and its crown lands for the use of these technical developments. However due to an error in the calculation of the dimension of the water tank he had failed to receive the preferential rights and the proposed remuneration of 50,000 guilders. He further added that he did not allow these set backs to discourage him but rather continued to work intensively on the development of these machines. In January 1783 Kempelen had begun a two year journey which took him through many European countries including England. On this journey through half of Europe the so-called "Schachtürke – the

automaton chess-player” and the speaking machine were demonstrated in many cities. But the journey also had another purpose. Kempelen wanted to gain some experience in England with the building of steam engines in order to improve his own developments. In London Wolfgang von Kempelen successfully filed his inventions at the patent office. He received his patent and came into contact with Dr. Joseph Priestly and Matthew Boulton. They both visited Wolfgang von Kempelen in his London quarters and examined his model of the steam reaction engine. After his meeting Boulton wrote to Watt that von Kempelen was “a very ingenious automaton maker.....and a good sort of man” and that he “wants both knowledge and practise in steam engines”. He reassured Watt that he had not given away the secrets of the Watt Steam Engine however he did not want to break off contact with von Kempelen since he saw in him the opportunity of a business partnership in the future for the sales and distribution of the English steam engine in the Austrian Empire.

At the end of August 1788 Wolfgang von Kempelen finally received his long awaited preferential rights for his two engines for the Austrian Imperial dominions including the Kingdom of Hungary. He remained in contact with England.

Matthew PASKINS | University College London, United Kingdom

Simple machines

A standard way of praising machines in the long eighteenth century was to say they were ‘simple’. I argue that recovering discourses around mechanical simplicity reopens questions of the significance of machines and the relations between innovation and use: this qualifies the singular ‘meaning for machines’ for which Larry Stewart has argued during this period (Larry Stewart, “A Meaning for Machines: Modernity, Utility, and the Eighteenth - Century British Public” *The Journal of Modern History*, Vol. 70, No. 2 (June 1998), pp. 259-294.”) This history of machines encompasses ventilators, agricultural tools, safety equipment, and hand-mills, as well as steam-engines, waterwheels and scientific instruments. It helps to make sense of the otherwise puzzling fact, observed by Musson and Robinson, that Stephen Hales’ ventilators were the most heavily advertised machines of the eighteenth century. (Albert Musson and Eric Robinson, *Science and Technology in the Industrial Revolution* (Manchester: Manchester University Press, 1969), pps 378-9, 384-7.) Mechanical simplicity during this period involved a cluster of interrelated senses, all of which were significant for their evaluation within working worlds during this period. These senses included: openness to scrutiny, freedom from friction, analogical connection to natural processes, partaking in divisions of labour, and adaptability in multiple circumstances. The primary archive for my analysis is the premium awards made by the Society for the Encouragement of Arts, Manufactures, and Commerce – a London-based economic society founded in 1754, which offered small inducements and supported numerous simple machines. I have two goals: to give a picture of significant aspects eighteenth century mechanical culture embedded in its own local context rather than answerable to an unknown future; and to explain how a particular vision of public life, represented by the Society, led to the valuing of these particular devices.

Thomas PALMELUND JOHANSEN | Aarhus University, Denmark

Useful knowledge at work in the legitimation of machinery: Charles Knight as a ‘second-hand dealer in ideas’

In this paper, I explore the alleged relation between knowledge, wealth and historical development in this middle-class attempts to calm down potential violent protests against the introduction of machinery in the second quarter of nineteenth century England. I will do so by analysing the two most famous of editor, publisher, and public educator Charles Knight’s own writings, *The Result of Machinery* (1831) and *The Rights of Industry* (1831). It is my argument that political economy came to deliver

the theory of history and historical progress that forms the platform on which Knight explained the nature of technological, economic, and moral progress. The three key elements in Knight’s idea of progress in prosperity of all classes of society were: teaching of scientific knowledge, the principle of division of labour, and the security of private property.

The introduction of new machinery in manufactures and agricultural production during the first decades of the nineteenth century was met with both high expectations and fierce resistance. It was the task of the emerging discipline of political economy to deliver the theoretical explanation of the social change that followed the extensive use of machinery. Additionally, as Maxine Berg has demonstrated in her book *The Machinery Question and Making of Political Economy* (1980) this very task also became formative for the new discipline. Below the level of abstract theory middle-class reformers, as a response to the changes in the labour market, set out to educate the working classes in what they labelled “scientific” and “useful” knowledge. The intention was to help the lower classes to be able to help themselves. These middle-men, or, in the words of Austrian-British economist Friedrich von Hayek, ‘second-hand dealer in ideas’ drew heavily on political economy in their legitimation of machinery and their advocacy for public science education. Charles Knight, publisher of most of the works of the Society for the Diffusion of Useful Knowledge, can, I will argue, be seen as a ‘second-hand dealer in ideas’ within the context of responding to the working classes’ concerns for their livelihood and the eradication of traditional forms of employment and ways of life.

T181-C. Eighteenth- and nineteenth-century science and engineering

Mon 22 July, 16:10–17:40 ▪ Uni Place 4.205

Chair: Julia ELTON | Newcomen Society, United Kingdom

Matteo CORSO | University of Cagliari, Italy

The lunar challenge: science, politics and social legitimation in eighteenth-century Birmingham

Birmingham’s Lunar Society was the perfect setting for a number of important joint ventures involving several of the greatest pioneers of modern capitalism, such as M. Boulton, J. Wedgwood, and men of science like J. Watt, J. Priestley and E. Darwin. R.E. Schofield’s (1963) and A. Musson’s (1969) classic studies underlined the relationship between this group of intellectuals and the Industrial Revolution, paying particular attention to the relation between scientific research, technical innovation and economic development. More recent research by R. Porter (1980) and P. Jones (2008) has gone some way to placing the Society within the general framework of provincial industrial illuminism. This paper aims to reexamine the lively debate between the perspicacious members of the Lunar Society and London’s scientific, political and economic world. In particular, it provides interesting food for thought on how the lunaticks actually promoted interests linked to local development, both in terms of scientific communication and political relations and how they saw London as a competitive place, the scene of social legalization and the raising of scientific prestige. Clear indications of the relationship between the Lunar men, the London establishment and the other institutions of the realm can be seen, for example, from events regarding the political debate over Watt’s request for a patent renewal for his separate condenser, with a resulting decisive effect on research into the steam engine and its use in industry. In turn, Wedgwood saw London as an important showcase to promote his wares. The quest for a wider market for his goods pushed him to the experimentation of new models, materials and production methods. His technical expertise and fruitful association with Watt and Priestley gave rise to the “pyrometer” and acknowledgement by the Royal Society. The Birmingham society engaged in lively exchanges with the capital’s scientific associations, particularly with the Society for the encouragement of arts and the Royal Society, of which nearly all the Birmingham members became fellows. The Lunar Society members

presented numerous political proposals and petitions to Parliament for the modernization of their local working area. Consequently, London became the political and cultural interlocutor for a group of rising provincial bourgeois, whose scientific curiosity and dedication to experimentation were to drastically change the history of modern England.

Kristen SCHRANZ | University of Toronto, Canada

The successful Tipton Works of Mr Keir: networks of conversants, chemicals, canals and coalmines

The development and growth of James Keir's Tipton Chemical Works at the close of the eighteenth century can be attributed to its unique position within a network of intense scientific communication, practical chemical materials and rich geographic resources. Keir's chemical industry was first and foremost enmeshed in an extensive intellectual and scientific grid consisting of the Lunar Society of Birmingham and its peripheral members. Fruitful correspondence and frequent meetings wove together the skills of savants and fabricants, fomenting scientific, industrial and legal dialogues that definitively shaped the birth and growth of Keir's alkali and soap making pursuits at the Tipton Chemical Works. Additionally layered upon this savant-fabricant network was a material web of chemical reagents and products. The development of Keir's synthetic soda process rendered useful the industrial waste from nearby factories. The resulting soda of commerce was then employed in saponification and glass making, signifying that Keir's manufactory was just one point on a larger interrelated web of chemical industry in the West Midlands. Mechanical intuition governed this material network of production, as did theorization to some extent. Finally, the physical location of Keir's Chemical Works epitomized the necessity of carving out prime territory in a burgeoning industrial landscape. His chemical manufactory was geographically situated at the heart of an ideal network of expanding transport canals and rich coal seams. This micro history of Keir's chemical business will expose the necessary overlap of human, material and geographic networks that stimulated eighteenth century industry in the West Midlands. While it is meant to be a slice within the greater historical landscape of this era, Keir's extensive networks will invite a teasing out of wider social, scientific and economic themes.

Sayaka OKI | Hiroshima University, Japan

River and canal works as a field of conflict for scientific expertise in eighteenth-century France: engineers, academicians and the state

The procedures of expertise for river and canal works were not fully standardized in 18th-century France, unlike some regions of Europe, such as England and Duchy of Milan, where recourse to expertise had become a normal procedure during the course of the 16th century. The aim of this talk is to show how this lack of decisive administrative structure of expertise in France finally contributed to the generation of a new role for scientists in the expertise of public works in the latter half of the 18th century. It was in the 1770s that the Royal Academy of Sciences of Paris got involved in some of the canal construction works, as a sort of technological consultant. However, things did not proceed in a straight line. Though the Academy was an institution mainly specializing in scientific research, it had members of different professional backgrounds, and there existed rivalries between some of them to determine who led the expertise of the projects in question. On one hand, there were members with civil engineering skills and institutional backgrounds, like J. R. Perronet of the Corps des Ponts et Chaussées and his subordinate engineers; on the other hand, there were academician scientists who specialized in mathematical sciences (especially in theoretical mechanics), like D'Alembert and Condorcet. In the 1770s, it was the former who were chosen by the Academy to lead the expertise, mainly by their experience as engineers in supervising road and bridge construction. By contrast, the latter, the savants, were not able to be involved in those kinds of issues by official pathway, and

to do so, they used their connections with A. R. J. Turgot. In the 1780s, however, we see the apparition of a new division of works between the mathematical scientists and the engineers, especially in the case of the Canal of Yvette. After the proposal of a new plan for this project by Defer de la Nouerre, an engineer, the rivalry shifted to the two engineers who had different conceptions. In this situation, academician scientists, especially mathematicians, took the role of judges of opposing plans. Under the Calonne's administration, which promoted the engagement of scholars' commissions in the decision-making processes in general, the academician scientists seized the opportunity to consolidate their roles as scientific experts by their ability to mobilise several domains of scientific knowledge.

Richard BYROM | University of Huddersfield, United Kingdom

Icons of the Victorian waterfront: the evolution, triumph and demise of the Fairbairn tubular crane, 1850-65

This paper examines one area of the work of the mid-nineteenth century Manchester engineer, William Fairbairn (1789-1874), namely, 'Fairbairn' cranes.

It shows technology from his iron shipbuilding influencing his design of the Britannia Tubular Bridge, rather than vice versa, and the transfer of that technology to tubular swan-neck cranes, patented in 1850. Robert Stephenson's statement that Fairbairn's experience of iron structures "is greater than any other man's in England" is noted. Construction of the cranes is examined.

Reasons are given, including the 1851 Exhibition, for the speed at which this type of crane (including the strongest in the world) became first choice for docks and shipyards, for a window of opportunity barely more than the decade of the 1850s, when 'Fairbairn' cranes were exported throughout Europe and to Australia. The diffusion of technology is followed to Holland, and thence to Yokosuka, Japan, after the visit of a Japanese delegation to the west for the 1862 London Exhibition.

The paper then shows how the 'Fairbairn' crane was challenged by others, including an 1859 swan-neck with lattice sides at Dublin, by Wm Anderson, who had been one of Fairbairn's premium apprentices. Other derivatives are examined, including cranes serving the steam hammer at Le Creusot, and railway travelling cranes.

By the mid 1860s 'Fairbairn' cranes were ousted by lattice jibs and Titans, with steam power replaced by hydraulic or electric. In the first decades of the 20th century most 'Fairbairn' cranes were unceremoniously scrapped.

A continuing area of influence of these cranes is orthopaedics, due to the interdisciplinary work of the German engineer Karl Culmann and the Swiss anatomist Georg von Meyer in the 1850s. Culmann's drawing of the stresses in Fairbairn's crane was found to resemble von Meyer's trabecular drawing of the proximal femur. This research has continued and is referred to in current textbooks and by C Jacobs in the *Journal of Rehabilitation Research and Development*, where he states that the work of Culmann and von Meyer has led in the 21st century "to novel technology with the potential to revolutionise the clinical treatment of cancellous bones".

The paper ends with reference to the conservation of the few remaining 'Fairbairn' cranes.

T182. Post-Second World War science and technology

Tue 23 July, 09:10–17:40 • Uni Place 2.219

T182-A. Postwar contexts

Tue 23 July, 09:10–10:40 ▪ Uni Place 2.219

Chair: Sam ROBINSON | University of Manchester, United Kingdom

Christopher BISSELL | Open University, United Kingdom

Control in the Cold War: the genesis and early years of the International Federation of Automatic Control

1956 was a turning point for the emerging discipline of automatic control. The approach known as classical control had emerged from WW2 as a result of collaboration between electronics, communications and mechanical engineers, predominantly in the USA and UK, but to a lesser extent in Germany. Developments in this area in the USSR were less significant, but an important novel approach to non-linear dynamics had been researched there in a control context since the 1930s.

At least eight conferences were held in Europe in 1956, including an international one in Paris in June. In retrospect, however, the seminal event was the conference in Heidelberg in September organized jointly by the two German engineering societies VDE / VDI. This drew wide international participation, including delegates from Eastern Europe and Japan; but perhaps most importantly it marked the inception of IFAC, the International Federation of Automatic Control.

Prompted by the growing internationalization of control engineering, and the Cold War climate of the mid 1950s, a number of delegates to the Heidelberg conference expressed interest in establishing a new, international, association. A meeting of 25 interested participants was held and a resolution adopted to found "an international federation of automatic control". A provisional committee was set up which met at the offices of the VDI/VDE specialist control group in Düsseldorf in April 1957, and IFAC came into being at a meeting in Paris in September that year. IFAC's constitution provided for one National Member Organization (NMO) per nation state. Countries such as the USA and the UK with more than one technical society with interests in the field established new overarching NMOs such as the American and UK Automatic Control Councils.

The 1960 IFAC Moscow Congress was a huge affair, and an important event in the development of automatic control. A number of seminal papers in the new area of modern control were presented, perhaps the most famous being Kalman's paper on his radical approach to linear filtering and prediction. It was also an opportunity for a meeting between East and West, even though Soviet suspicion limited informal contact between Russians and international delegates.

This paper will examine the early development of IFAC and the contribution it made to international collaboration in the field of automatic control during the Cold War.

Audra WOLFE | Independent Scholar, United States

Science, freedom, and the American way

Nearly a quarter-century after the fall of the Berlin Wall, historians of science are only beginning to grasp the role of the Cold War in defining our own field. The most suggestive of recent scholarship on this topic has pointed to the shared intellectual currents that pushed Merton, Polanyi, and Kuhn toward interpretations of the scientific process that fit neatly with postwar American conceptions of the liberal democratic society. But—discussions of Polanyi's involvement with the CIA-funded Congress for Cultural Freedom excepted—little of this promising research has focused on the institutional and political work that went into creating these convergences.

Beginning in the mid-1950s, both the United States and the Soviet Union looked to science and technology as key tools for demonstrating the superiority of their respective systems. Communist leaders trumpeted the accomplishments of central planning in transforming agricultural economies into industrial powerhouses. In contrast, the United States offered the very structure of science—supposedly open, international,

and free from government interference—as a beacon of freedom to citizens of the world.

In keeping with the Congress's theme of "Knowledge at Work," this paper examines the work of solidifying and disseminating Western Cold War ideas on the structure and function of science as a free and objective enterprise best conducted within liberal democracies. Using archival evidence gleaned from the (U.S.) National Archives and Records Administration, the Hoover Institution Library and Archives, the Rockefeller Archives Center, and the American Philosophical Society, this paper traces the emergence of a U.S. foreign policy consensus that saw science, American-style, as a "big idea" that would help the nation win the ideological battle against Communism. U.S. science attachés, State Department science advisors, embassy officials, and other low-level diplomats actively promoted this vision of science to allies—and would-be allies—through lectures, research grants, exchange programs, textbook translations, science clubs, and other similar actions.

Collectively, these documents make clear that science joined art, music, and sport on the Cold War cultural front. If we, as historians, wish to develop a better understanding of the role of culture in the development of scientific ideas, it is critical that we acknowledge the role of a culturally specific ideology in shaping our own field.

Ronan LE ROUX | Université Paris 1 Panthéon-Sorbonne EA 2483 CETCOPRA, France

From metaphors to operational models: putting cybernetic concepts at work in postwar France (or not)

Among the literature addressing the topic of cross-disciplinary circulation of concepts, studies in the history of cybernetics have become numerous. Interdisciplinary profiles, meetings and collaborations have been under growing scrutiny, whether at the scale of individuals, small groups or whole national or transnational contexts. However, it remains not so clear what the scientific outcome of such conceptual circulations is. There is no homogeneous picture of the epistemological contribution and the value of results brought by cybernetic concepts (thus some authors both state that cybernetics invaded whole fields of knowledge, but was a failure at the same time). Several factors may account for this blurred situation. On the one hand, attention was devoted mainly to a micro-historical prosopography of initiators (as with the conferences for cybernetics held by the Macy Foundation between 1945 and 1953), with insufficient focus on larger-scale, longer-term downstream disciplinary integration. On the other hand, approaches from cultural studies of science have based their analysis on actors' discourse rather than practices. Such approaches view conceptual transfers as metaphors or lexical transfers, that is, as linguistic processes. While they worked on fruitful historical contexts where discourse and practices overlap, the case of France does not fit this picture. France after the *Libération* turned out to be a kind of "no man's land" for cybernetic modelling. Fascination of the general public contrasted with the lack of actual investment in scientific collaborations. It turned out that everybody would talk about cybernetics, but nobody would get involved in actual cross-disciplinary modelling practices. Hence a culturalist approach does not properly account for whether and how concepts are put at work (or not). For example, it does not address appropriately the question why, while concepts were available immediately after the War, it took them about five decades to be fully integrated as an operational cornerstone in the modelization of biomolecular pathways. This example will be illustrated from the first introductions of the feedback-control concept in biochemistry to the actual state of systems biology.

T182-B. Organisations

Tue 23 July, 11:10–12:40 ▪ Uni Place 2.219

Chair: Stuart BUTLER | University of Manchester, United Kingdom

Francisco QUEIROZ | Universidade de São Paulo, Brazil

FAPESP: a history of science, technology and innovation in Brazil

The Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) is a distinctive scientific and technology research funding agency in Brazil, that supports grants and research projects in one of the most industrialized states and where three of the most important public universities of the country are located. The vital landmarks of its history are connected to the 1940s, in the post-war period, when a new industrialization process started. It is also in such period that the discussions on the scientific and technological policies definition are intensified.

Even though it was established in 1947's State Constitution, FAPESP was implemented in the early 1960s with financial and scientific autonomy, i.e., with freedom to define its own research agenda. In the late 1980s, FAPESP's budget increased from 0.5% to 1% of the state tax collection to reach appropriately the new demands from other society sectors, such as the need to expand the technological research in a partnership with the industry. The funds have also been essential to develop scientific projects with local and overseas reach. The researches supported and developed encompass all the knowledge fields, from cosmic rays to health, from the environment to microelectronics, from climate changes to bioenergy, from internet to genome, among others. Through all FAPESP's history, a high quality level has always been required from its projects, as per the peer and external consultant review scientific standard.

The goal of this article is to describe and analyze FAPESP's history over its 50 years of activities, based on three different stages. The first one, from 1962 to 1989, could be defined as *laissez-faire*, in which the scientific and technological spontaneous demands servicing was focused. The second one, from 1990 to 2006, was a modernization stage in relation to the current procedures of the scientific and technological policy with spontaneous and induced demands; and the third one, the internationalization stage, in which the Brazilian research relation expansion and deepening fostering is presented and evidenced, especially the production of the state of São Paulo, with acknowledged excellence scientific research international centers.

This presentation is based on work co-authored by Marilda Nagamini and Paulo Escada.

Maria GAGO | Institute of Social Sciences, Portugal

Postwar 'scientific cooperation' and the late Portuguese empire: the emergence of the Coffee Rust Research Center

In 1952, two American agricultural scientists visited the National Agronomic Station (EAN) in Lisbon, Portugal. Frederick Wellman and William Cowgill were at the onset of a travel across the world, which aimed to prevent the spread of *Hemileia vastatrix* to the American continent. In the 19th century, this fungus had almost totally destroyed Arabica coffee plantations in Africa, Asia and Oceania. Branquinho de Oliveira, head of the plant pathology department of EAN, was invited to act as a partner. He became responsible for the accommodation of coffee plants and rusts collected by the two Americans during the worldwide travel, and the material gave place to a new research line. Gradually, the idea of a new institution, to assist all coffee research centers in the world and located in Portuguese soil, emerged. An agreement was eventually signed between both governments and funds of the Foreign Operations Administration were used to create the Coffee Rust Research Centre (CIFC) in 1955, near Lisbon. Environmental conditions were the alleged reason as to why Portugal, a warm and sunny country, was considered an ideal place to centralize physiological and breeding experiments with a tropical plant such as coffee. Is this enough to explain, however, why the United States would pick such a strange bed-fellow? Was Portuguese imperialism, under fire from the international community, a hidden part of the equation? Firmly rooted in

the CIFC's correspondence, which has remained intact and untouched until today, the present investigation follows the trans-imperial (or transnational) circulation of seeds, plant clones and fungus enlisted to participate on a fight against what was considered to be the most dangerous threat to coffee production. This paper is not about the impact of a plague or new cultivar. It's a story about an idea of a plague and how diplomatic, political and even epistemological wedges, separating the 'free world' from authoritarian and colonialist Europe, were bracketed, under the sign of 'scientific cooperation'.

Antonio Carlos V. AMARAL | CENTRO UNIVERSITÁRIO DE CARATINGA-UNEC, Brazil

Joice Meire RODRIGUES | CENTRO UNIVERSITÁRIO DE CARATINGA-UNEC, Brazil

João Batista ALVES DOS REIS | CENTRO UNIVERSITÁRIO DE CARATINGA-UNEC, Brazil

ALGUNS ASPECTOS DO DIÁLOGO ENTRE LUDWIG VON BERTALANFFY E KENNETH EWART BOULDING (1953 – 1972): A TEORIA GERAL DE SISTEMAS NAS ORGANIZAÇÕES SOCIAIS.

Este trabalho visa analisar o livro *General System Theory: Foundations, Development, Applications* de Ludwig von Bertalanffy (1901-1972), no qual o pesquisador apresenta os relatos de seus estudos em épocas distintas (1940-1968), que o levaram à formulação da Teoria Geral de Sistemas, bem como outros trabalhos e artigos de Bertalanffy e uma parte da correspondência (enviada e recebida) por personalidades da época, cientistas, autoridades, dentre outros. Focalizam-se neste trabalho algumas influências dos estudos e pesquisas de Bertalanffy sobre o desenvolvimento das organizações sociais, através da economia e da administração. Verificou-se, em especial conceitos propostos a partir dos diálogos entre o biólogo Ludwig von Bertalanffy e o economista Kenneth Ewart Boulding e das discussões sobre suas contribuições científicas para o desenvolvimento de novas teorias. Aborda-se também o papel desse diálogo na criação da Society for General Systems Research e, por fim, algumas considerações sobre os impactos de Teoria Geral dos Sistemas nas Ciências Sociais da segunda metade do século XX.

Some aspects of the dialogue of Ludwig von Bertalanffy and Kenneth Ewart Boulding, 1953-1972: a general theory of systems in social organizations

This paper aims to analyze the book *General System Theory: Foundations, Development, Applications* by Ludwig von Bertalanffy (1901-1972), published in 1968, in which the researcher presents results of his studies in distinct eras (1940-1968), that led him to the formulation of General Systems Theory – GST as well as other works and articles from Bertalanffy and some of the letters (sent and received) by personalities of the era, scientists, authorities, among others. This work is focused on some of the influences of Bertalanffy's studies and research about the development on the social organizations, through the economy and administration. It was found, especially in particular concepts proposed from the dialogues between the biologist Ludwig von Bertalanffy and the economist Kenneth Ewart Boulding and discussions about their scientific contributions to the development of new theories. It also discusses the role of dialogue in the creation of the Society for General Systems Research, and finally, some considerations about the impacts of General Systems Theory in Social Sciences from the second half of the twentieth century.

T182-C. The politics of science, technology and medicine in the European context

Tue 23 July, 14:10–15:40 • Uni Place 2.219

Chair: James EVANS | University of Puget Sound, United States

Stuart BUTLER | University of Manchester, United Kingdom

Shooting itself in the foot? Technological collaboration in the Wilson government's 'approach to Europe'

It has often been said that Britain's second application to the European Communities in 1967 was doomed to failure. Harold Wilson is accused of applying for all the wrong reasons: to unite his Party, to steal a march on the Conservatives, and to distract attention from the recent devaluation of sterling. A similarly negative picture of technological collaboration under Wilson is portrayed: within a month of proposing the European Technological Community, Britain had excluded France from a tripartite agreement on the production of a gas-centrifuge, caused severe crises in ESRO, ELDO and CERN, and offended the committee of the European Atomic Energy Community. Significantly, however, Wilson's science and technology policy is often viewed without reference to that of earlier governments. Examining the effects of earlier policy, this paper will determine the extent to which Wilson stymied the negotiations himself by rushed announcements of new policy, and the extent to which Wilson was forced into acting by unfavourable circumstances created in part by the expediency of the previous Macmillan government.

Thomas KAISERFELD | Lund University, Sweden

Organizational resilience in Big Science: the survival of the European Spallation Source in a changing research-policy climate

Studies of Big Science have early on focused on instrumentation and scientific co-operation in complex policy contexts, later on to take into account symbolic values and specific research styles and more recently also involving the involvement and trading of commercial interests and economic development as well as the assimilation of research traditions. In accordance with these transformed practices, this presentation will analyse how an organization with the purpose of realizing a Big-Science facility, The European Spallation Source, has successfully managed to both present the project as relevant to different national and international policy-makers, to the community of European neutron researchers as well as to different industrial interests. All this has been achieved in a research-policy environment, which has been the subject to drastic transformations, from calls to engage researchers from the former eastern bloc in the early 1990s via competition with American and Asian researchers at the turn of the century 2000 to intensified demands on business applications. During this process, there has also been fierce competition between different potential sites in the U.K., Germany, Spain, Hungary and Sweden, not once, but twice. The project has in addition been plagued by withdrawals of key actors as well as challenging problems in the field of spallation-source construction. Nevertheless, the European Spallation Source has survived from the early 1990s until today and has now initiated the process of negotiating financing and contributions between the 17 partner countries that have pledged to make an effort to realize this facility at Lund in southern Sweden. In this presentation, the different measures taken and arguments raised by the European Spallation Source project in order to realize the facility will be analysed by applying the concept of organizational resilience. Within this framework, the different designs of the European Spallation Source will also be analysed as responses to external demands and threats.

Claas KIRCHHELLE | University of Oxford, United Kingdom

Negotiating risk: agricultural antibiotics and the making of European health, 1945-2006

Few substances have experienced a more dramatic image change than agricultural antibiotics in the 20th century. Once celebrated as miracle substances, agricultural antibiotics are now blamed for creating resistant pathogens, leaving residues in both food and the environment and glossing over animal maltreatment on farms. The history of antibiotics' malleable image thus exemplifies the rise of a new style of Western reflexivity regarding health, food and environmental ethics and safety after the Second World War.

Pioneered by the United States in the early 1950s, the use of agricultural antibiotics was quickly adopted by European nations. However, Europeans' carefree attitude towards widespread antibiotic use changed quite abruptly during the early 1960s: sensitized by food and pharmaceutical scandals, a pervasive fear of hidden carcinogens and the publication of *Silent Spring* and *Animal Machines*, European consumers grew increasingly sceptical of anything 'chemical' in their food and environment. Substances as distinct as hormones, DDT, pesticides and antibiotics were referred to as dangerous 'chemistry'. In 1966, studies on bacterial resistance-communication via plasmid-exchange further damaged agricultural antibiotics' already tainted image. The convergence of public and expert discourses on antibiotics' risk now led to demands for government action.

Based on public media reports, agricultural media coverage, expert publications and internal government communication in Germany and the UK, my paper will trace the history of antibiotics in European agriculture between 1945 and 2006. I will focus particularly on West Germany and the United Kingdom – one nation firmly committed to European unification, the other repeatedly wavering about the degree of its commitment. By analysing agricultural antibiotics' cultural transition from agricultural helper to consumer danger, my paper will highlight the historical dynamics surrounding the creation of shared European health and food ideals. In particular, I intend to analyse how protagonists developed distinct strategies to negotiate the notion of risk that suddenly surrounded the industrialized and antibiotic-dependent European food regime on national and transnational levels.

Phil JUDKINS | University of Buckingham, United Kingdom

'It's no good, René, they know': negotiating Franco-British armaments cooperation and the failure of the Anglo-French Variable-Geometry (AFVG) project, 1965-7

During the Cold War, the escalating costs of the design and development of new military weapons technologies prompted European governments to look to cooperative armaments programmes as a means of sustaining and enhancing European military technological capabilities. Whilst the failure of some of these armaments cooperation initiatives at the negotiation stage has been noted in passing (see for instance, Matthews, 1992; Bitzinger, 1994) there has been little or no discussion of the nature of the negotiation process between governments on armaments cooperation programmes, nor any discussion as to why negotiations have succeeded or failed. Our paper will provide a case study of the challenges of creating the conditions for knowledge-making and knowledge-use in such programmes by examining the Anglo-French Variable Geometry (AFVG) military aircraft programme and the causes of French withdrawal from that programme in 1967. Uniquely, this paper will draw on material from French diplomatic and corporate archives (in particular those of the French aircraft company Dassault) in addition to UK government and corporate archives to explore the reasons behind the collapse of the negotiations. The paper illustrates the balance that sovereign nations have to strike between defending their own interests in joint projects and seeking mutual benefit from them. Our account contributes to debates about the nature of government-to-government negotiations by emphasising the impact of power asymmetries between the French and the British, the role of parallel Government agreements

with domestic (primarily French industrial) interests and the escalating commitment of the British to what many observers saw as a failing course of action.

T182-D. The nuclear Pacific

Tue 23 July, 16:10–17:40 ▪ Uni Place 2.219

Chair: Roy MACLEOD | University of Sydney, Australia

JUNYI Zhang | Institution of Science Technology & Society, School of Social Sciences, Tsinghua University, China

Nuclear technology in the Chinese context: the case study of the development of the Chinese mainland civil nuclear emergency management system

“Nuclear emergency” is “the event of a nuclear accident or radiological emergency”, according to IAEA. Civil nuclear emergency system is a part of nuclear safety and the bottom line of the “defense-in-depth” measure, which aimed to act against the nuclear accident to lessen the radioactive harm, protect staff, the public and the environment. Echoed with the development of nuclear power industry in 1980s, Chinese mainland civil nuclear emergency system is paid much attention by the government after the Chernobyl accident in 1986. A great many nuclear experts agree that the system puts more weight on technology, and the framework of management is the centralized embodiment of the system. This study focuses on the development of the Chinese mainland civil nuclear emergency management system, taking a historic view of science and technology. Specifically, it conducted semi-structured interviews with the core participants who established the nuclear emergency management system in the 1980s, including officials, nuclear technology experts and military delegates. The author acquired primary materials, such as work scripts, conference minutes and internal materials and gained a comprehensive understanding of the preparation, establishment and reform of this system. This study draws an outline of the development path and the characteristics of Chinese mainland civil nuclear emergency organization system. This system was formed in a unique circumstance that China is transforming from a planned economy to a more open market economy. On August 21th, 1991, the National Nuclear Emergency Committee announced the “State-Province-Nuclear facilities unit”, three levels of civil nuclear emergency organization system, had officially established. With the power of directing and coordinating eighteen ministries and commissions, this committee was affiliated directly under the State Council and led by the Vice Prime Minister. However, as the shadow of major nuclear accidents eliminated gradually, and a one-sided pursuit of economic interests took hold, the strength of nuclear emergency system was weakened. As a consequence, during the national ministerial reform from 1993 to 1995, the executive grade of the National Nuclear Emergency Committee was degraded. Later in 1998, it turned into a subordinate unit of the COSTIND. Therefore, it is a hidden danger that the Committee is powerless to mobilize the national strength in case of a serious nuclear accident.

Kenzo OKUDA | Independent Scholar, Japan

The introduction of the first nuclear reactor to Japan and Japan-UK relations in the Cold War

In December 1953, US President Dwight D. Eisenhower delivered his “Atoms for Peace” address at the United Nations General Assembly. The following year, the US tested the hydrogen bomb in Bikini Atoll creating a deadly nuclear fallout affecting Japan’s fishermen. These two events marked the beginning of the introduction of atomic energy in Japan. Sponsored by Hidetoshi Shibata, director of Nippon Television Network Corporation, “the Atomic Energy Peace Mission” led by John Jay Hopkins, president of General Dynamics Corporation visited Japan in May 1955. In spite of this American effort, it was the British built Calder Hall type reactor that was adopted as the first commercial reactor in

Japan. This paper focuses on the role of nuclear reactors in Japan-UK relations during the Cold War Era.

In January 1946, the UK Atomic Energy Research Establishment Harwell was established to study atomic energy factories for not only for military use but also for peaceful use. Headed by the Nobel Prize physicist John Cockcroft, the institute developed a gas-cooled and graphite moderated reactor. Its construction of the Calder Hall nuclear power plant began in April 1953, in the early period of the Cold War.

Wishing to set up a nuclear power plant, Japan began to pay a close attention to the Calder Hall nuclear power plant under construction in the UK. In April 1956, Sir Christopher Hinton, Director of the UK Atomic Energy Authority visited Japan. With Sir Esler Denning, Ambassador to Japan, Hinton had talks with Matsutarō Shoriki, Chairman of Atomic Energy Commission, Shibata and Dr. Ryokichi Sagane on the Calder Hall type reactor. Shoriki had a good impression of this reactor. They reached an agreement on introducing to Japan a Calder Hall type commercial power plant from the UK.

However, the UK was still uneasy about the introduction of nuclear power plant to Japan: Given its frequent earthquakes, was it really possible to construct a nuclear power plant in Japan? Was it possible to reach an agreement on supplying uranium or plutonium to Japan on a commercial base? To negotiate the situation, Ichiro Ishikawa, Chairman of the Japan Business Federation, Shibata, Sagane and others visited the UK in October 1956. Finally, in 1965, the Calder Hall type reactor operated Tokai-mura Nuclear Power Plant for the first time. Introducing a commercial nuclear reactor from the UK within a short time after Hopkins’ visit to Japan was a big change for Japanese atomic energy strategy.

Hyomin KIM | Ulsan National Institute of Science and Technology, Korea, Republic of

Engaging the heterogeneous publics in making decisions: a Korean history of nuclear energy policy

Korean nuclear energy regulatory policies are noted to have changed from earlier exclusive technocracy into open dialogues since the late 1980s after the nation’s political democratization. However, technocratic policies still co-exists with new regulatory terms such as openness, transparency and mutual learning between the lay and the expert knowledge. This paper analyzes Korean nuclear regulatory policies since roughly 2005 as a blend of old and new governance. The paper does not aim to decide whether the governance is genuinely new and participatory; rather, it explores how the Korean history of nuclear energy development and social assumptions of its public interact with changing policy environments. The case of Korean nuclear policies serves as a site to analyze how certain forms of the ‘public’ and ‘public participation’ are produced and reproduced through continued boundary work between science and society with new science and technology governance.

Masakatsu YAMAZAKI | Tokyo Institute of Technology, Japan

Reporting to Europe the suffering from radiation exposure caused by the Bikini H-bomb

The existence of uranium 237 in “ashes of death” from the Bikini bomb in 1954 suggested that it was a “dirty bomb” because uranium 237 was a typical isotope produced from uranium 238 by bombing with such fast neutrons as those from fusion reactions. The evidence of uranium 237 was first reported by Japanese scientists including Ken-jiro Kimura at the University of Tokyo. It was Joseph Rotblat that first found the Bikini bomb was so-called “3 F” (fission (primary)-fusion (secondary)-fission) bomb. He received the radiological data of the bomb from Yasushi Nishiwaki (1917-2011), then an associate professor at Osaka City Medical College and later a professor at the Tokyo Institute of Technology. This paper studies how Nishiwaki met Rotblat to convey the

data, especially an estimation of fallout on the Japanese fishing vessel, *Daigo Fukuryu Maru* (*Lucky Dragon No. 5*).

Yasushi Nishiwaki was one of the first scientists who studied radiation of the *Daigo Fukuryu Maru* at the port of Yaizu, its mother port in Shizuoka Prefecture. With the radiological data gathered by Japanese scientists, he and his American wife Jane traveled for four months, from July to November 1954, to at least about nine European countries including the UK, France, Belgium, Germany, and Sweden. Nishiwaki gave lectures at various places, universities and public halls. The amount of money they needed was a lot. It was said to be around two million yen which is almost two hundred thousand Euros at current rate. Anti-H bomb groups in the Osaka area financially supported their trip. Nishiwaki met at the end of August Rotblat on the occasion of the (first) international conference on radiobiology at Liege University, Belgium. Nishiwaki gave Rotblat a memorandum about ashes of death on the *Daigo Fukuryu Maru*, from which Rotblat could estimate the amount of radioactive substances from the Bikini test. He was surprised to see an unexpectedly high amount of fallout. This resulted in his speculation that the bomb was surrounded with ordinary uranium which, with fast neutrons from the secondary fusion bomb, produced much more fission products than the primary fission bomb. Rotblat then told Bertrand Russell his speculation about the Bikini bomb. This made Russell write in 1955 what became the "Russell-Einstein Manifesto."

This paper will also give an account of reactions to Nishiwaki's message in Europe. It argues that his message helped make Europe aware of the real suffering in spite of American propaganda that radiological effects from the Bikini bomb were not serious.

T183. Twentieth-century sciences in comparative (inter)national contexts

Wed 24 July, 09:10–15:40 • Uni Place 4.205

T183-A. Mid twentieth-century applied sciences

Wed 24 July, 09:10–10:40 • Uni Place 4.205

Chair: Hans-Joachim BRAUN | Helmut Schmidt University, Hamburg, Germany

Gong WANG | Institute of Science, Technology and Society, Tsinghua University, Beijing, China, China

YANG Jian | Institute of Science, Technology and Society, Tsinghua University, Beijing, China, China

Chenggang ZHANG | Institute of Science, Technology and Society, Tsinghua University, China

Science and technology in the rear area of China during World War II: a case study based on the Special Research Institute of Tsinghua University

The research on the scientific improvements during World War II is a hot topic of the history of science; however, among all the available work, it is not readily to find some about China. This paper focuses on investigating the activities of scientists and the scientific developments in the Rear Area of China during the World War II by exploring the history of Tsinghua University's Special Research Institutes. Main points of this paper include the background of founding the institution and its organization form, constitution of research staff, sources of subjects, scientific achievement as well as applications. Firstly, many scientists previously working home and abroad, came spontaneously together to the Rear Area when the war broke out. Such behavior was upheld and

financially supported by the Chinese Government thus helped scientists further conduct research relevant to the war. Secondly, the scientific development in the Rear Area of China has also supported the war of resistance to some extent, promoted the construction of the area and trained a lot of talent. Thirdly, during World War II, some scientists and intelligence officers of western countries, such as Joseph Needham, get to China in spite of obstacles. They sent information about the achievements in the Rear Area of China back to western countries through secret letters and publications. All of these aforementioned have demonstrated that the Chinese scientific developments during World War II occupied a significant position in that of the whole world. This paper aims to make some contributions to the study of the history of scientific improvement during World War II.

WANG Jianan | Institute for Science, Technology and Society, China

YANG Jian | Institute of Science, Technology and Society, Tsinghua University, Beijing, China, China

The research of agricultural science in China during World War II

As a crucial part of Asian continent during the Word War II , China was hit hard. A consortium of academics and scientists returned with patriotic enthusiasm to begin a new age. Concerning the important role that agricultural institution of Tsinghua University has played in agricultural science research during the Word War II , many scholars, including Dr. Joseph Needham, have worked on studying agricultural institution. This paper is focus on the characteristics of agricultural science and technology during the Word War II other than some works of predecessors, such as specific research projects and significant research findings and formation of discipline on agriculture science.

Firstly, this paper presents history and members of studying groups, and traces the origin and results of research by documents and reports. Mei Yiqi, the president of Tsinghua University, has pointed out that solve the practical issues was the main aim of agricultural institution. Under the guidance of practicality scholars, who had studied abroad by the boxer indemnity, took full use of advanced knowledge and communicated with foreign experts, such as R.W.Gerard, Theodore.F.Dykstra, and so on. At that circumstance, traditional technologies, which have accumulated for thousands of years, combined with modern agricultural science have greatly influenced on the research the scholars done then.

Secondly, agricultural research organizations, researchers and topics in the whole country are classified and quantified. Though the concise description on the research of agricultural science, we intend to explore the communicative, practicability and regionalism on the research of agricultural science, reflected what was important and essential to the wartime China.

Finally, after a comprehensive survey on agricultural institution, it would be clear that the concerns of agricultural science research in the Word War II including three aspects, which making agricultural research at Word War II seems to be a paradox. It was hangovers of traditional agricultural questions, international concerns, and applications in military, that had manifested in most papers. Scientists, who have received the traditional education as a young teenager but admired modern science, were eager to promote the backward status of China. With these complex feelings, they are caring about reality of agriculture, communicating with foreign scholars on hotspot issues and converting studies into military equipment. That is to say applied agricultural science of china on agriculture was rise in the Word War II .

Shigeyuki AOKI | University of Aizu, Japan

Earth science before the plate tectonics revolution in Japan

It is widely acknowledged that the earth science – in the comprehensive sense in which the once diverse disciplines (geology, petrology,

palaeontology, seismology, paleomagnetism and geophysics) were united in one single branch – was formulated as a result of the plate tectonics revolution in the latter of the 1960s. So, the term “earth science” has been usually thought to denote that united, comprehensive discipline after that revolution.

In this paper, I would like to point out that as early as 1942 in Japan, some idea of the comprehensive discipline “earth science” already took shape in the minds of several geochemists (Yuji Shibata 1882-1980 and Ken Sugawara 1899-1982) around Nagoya University. The science school of the university was founded in 1942, and the new department of “earth sciences” was established in 1949. In this paper I will delineate three distinguished stages through which the department emerged and evolved.

The first stage was the *planning* stage. The plan of founding new “earth sciences” department occurred to the mind of Sugawara in 1942 when he travelled with Shibata. The idea was to “modernize” geological studies with physics and chemistry, as he himself wrote in his autobiography.

In the second, *founding* stage, the new schools (*Kyoshitsu*) were added on and new staff recruited. Beginning with structural geology school in 1949, petrology/mineralogy school (1950), geochemistry school (1951), geophysics school (1953), and historical geology school (1968) were added on. *Journal of Earth Sciences*, the first journal which has the title “earth science” in Japan, was published from 1953. However, still the barriers between the schools were high, as the name of the department and the journal “earth sciences” symbolizes.

The third, *growth* stage marked substantive developments toward “earth science”. A pioneering figure of this movement was Yasuo Shimazu (1926-) who advocated the “seamless” viewpoint in earth science. His book *Evolution of the Earth* appeared in 1967, which tried to go beyond morphology of the earth surface and inquiry into the evolution of the whole earth using the language of physics, while rejecting the traditional division of geology, geophysics and geochemistry. The year 1967 was exactly when the plate tectonics revolution was proceeding.

Augusto J. S. FITAS | Universidade de Évora, Portugal

The Junta de Educação Nacional and the organization of scientific research in Portugal between the two world wars

The main purpose of this paper is to give an historical overview on the genesis of the installation of scientific research in Portugal during the period between the two world wars. The creation of a National Board of Education — the JEN (Junta Nacional de Educação) — explains the effort to organize modern scientific research in the country, specially the grant service abroad and the support of scientific institutions (laboratories) in Portuguese Universities. We try to summarize the main results achieved by JEN guidelines of its program. In particular we want to expose the effect of implemented measures organized by the JEN's directive committee of providing an important group of students to continue their advanced studies both abroad and at home. This group of grant holders are specially related to mathematics, natural sciences and medicine. (This work was financed by funds FEDER through the Operational Competitiveness Factors Program (COMPETE) and national funds through FCT (Foundation for Science and Technology) by the project HC/0077/2009)

T183-B. UK state institutions in the twentieth century

Wed 24 July, 11:10–12:40 ▪ Uni Place 4.205

Chair: Anna GUAGNINI | Università di Bologna, Italy

Robert MACKINNON | Aberystwyth University, United Kingdom

‘Gradually science is taming the waters to work for man’: the work of the British government’s Hydraulics Research Station, 1945-1956

This paper takes a look at the setting up of an important work undertaken by the British government’s Hydraulics Research Station (HRS) in the 1940’s and 50’s. The research station, undertaking hydraulic research with the use of scale models for civil engineering projects, was set up by government in 1945. This was in response to a desire from both government and relevant interested bodies for a large-scale centre to undertake modelling work so as to assess various civil engineering strategies or discover the potential for them, besides harnessing and developing scientists/engineers for hydraulic modelling work in Britain and its Commonwealth and Empire. This paper firstly takes a look at the debates surrounding its setting up and the contextual and political issues involved in finding a suitable site for the laboratory, in particular the need for a suitable space where large-scale model work can be undertaken. Secondly, it examines the logics behind its architectural geographies before then, for the majority of the paper, through HRS’s model work on the Severn Barrage between 1945 and 1956, explores how this hydraulic model, calibrated to predict the future, was made, observed, encountered, contested, recalibrated, discussed over and contested among other things. This exploration will lead into discussions around issues of knowledge, temporality, movement, mimesis, materiality, scale, rhythm and turbulence among others and how material hydraulic simulations of future worlds are meant to ‘loop-back’ knowledge and become never through it.

Fiona SMYTH | University College Dublin, Ireland

‘464 forms of construction’: siteworks and the quest for acoustic data

The study of architectural acoustics made significant advances through the work of Harvard-based physicist W.C. Sabine in the closing years of the nineteenth century. The introduction of Sabine’s work to Britain in the early decades of the twentieth century and its furtherance as a building science was promoted by architect Hope Bagenal and physicist Alexander Wood. In the 1940s, construction began on three blocks of flats at Abbots Langley in Hertfordshire. The buildings represented one segment of large-scale housing project undertaken by Britain’s Building Research Station (BRS), a project with a two-fold purpose: to alleviate the contemporary housing shortage, and to provide full-scale working test sites for measuring and analysing the performance of different construction elements and methods. The three blocks of flats in question were significant to the overall programme in that they constituted the test sites for research into acoustic insulation. They were named Bagenal House, Rayleigh House, and Sabine House. In a play of letters, the nomenclature not only made reference to the initials of the BRS, it also paid homage to three significant contributors to the development of architectural acoustics: Philip Hope Edward Bagenal, Lord Rayleigh and Wallace Clement Sabine. The respective contributions of the latter two (both physicists) to the advancement of acoustic science is well-documented, and has been the subject of other dissertations. The former, Hope Bagenal, played a pivotal role in establishing the acoustic research agenda in Britain, introducing contemporaneous advances in the science to architectural application and adapting current scientific research and test methods to the context of the British construction industry. Throughout his lengthy professional career Hope Bagenal was preoccupied with the acquisition of measured acoustic data from myriad sites ranging from cathedrals to concert halls, inserting this corpus of information into his ongoing refinement of predictive models that were to be ultimately directive in the principles of design and construction. Continuous research, knowledge transfer, and real world applications reflected the achievements of a pioneer whose contributions to the BRS and the field of acoustics are discussed in this paper.

Richard FLETCHER | University of Surrey, United Kingdom

The development of cryptography research practices in the United Kingdom from 1970 to 2000

In the 1970s, research into cryptography began to change. Increasingly, cryptography research was undertaken outside of the military and other intelligence gathering organizations. Authors such as Steven Levy, Whitfield Diffie and Susan Landau have described the scientific work on encryption carried out by universities and corporations in the United States, and the policy debates over national security, export controls and individual privacy that followed. However, parallel developments in the UK are less well understood.

The 1970s also saw the start of a program of cryptography research in the UK. Cryptography research was carried out within a number of different organizations, including universities, the civil service, and in industry. Later, as the popularity of the Internet grew in the 1990s, tensions emerged between concerns over individual privacy and the viability of electronic commerce, on the one hand, and the law enforcement and national security on the other. This resulted in a controversy, consisting of a series of parliamentary debates, official consultations and prolonged attempts to enact legislation.

Using documentary analysis and qualitative interviews, details about how each research site designed and constructed encryption technologies has been uncovered. Examination of the practises employed at each of these sites has revealed a divergent set of methods, operations and goals. Subsequently, a picture of a set of technologies has emerged that, although ostensibly designed with security and the inhibition of surveillance and monitoring in mind, exhibit divergence in the range of localized practises that produced and sustained them. Furthermore, the ways in which cryptography research influenced the subsequent policy debates has been outlined. This has revealed some of the techniques employed by scientists to modify their research practices in order to produce viable policy arguments, and in turn, to become more effective political actors.

Andrew BLACK | The University of Manchester, United Kingdom

'The Tree and the Fruit': the British Medical Research Council and its search for an alternative explanation of scientific research.

When discussing the difference between 'pure' and 'applied' research in his insider history of the British Medical Research Council (MRC) published in 1973, Sir Arthur Lansborough Thomson (1890-1977), suggested: "Men of science themselves are apt to find little reality in such a distinction, and less utility in attempting to draw it". In this paper I will argue that as far as the MRC is concerned its senior members were acutely aware of the distinction, but were reluctant to define it due to the politically sensitive nature the terms had taken on. Instead, I argue that the MRC, under the supervision of its first secretary Sir Walter Morley Fletcher came up with an alternative way to articulate their 'pure' scientific agenda. In 1929 Fletcher delivered the Norman Lockyer Lecture under the heading *Medical Research: the Tree and the Fruit*. His address went on to articulate a similar metaphor for scientific research to that used three hundred years earlier by Francis Bacon. Fletcher stated, "We may know in the first place that as the body of accurate knowledge grows, like a tree with its stem and branches, fruit in practical usefulness will certainly come in due course". Fletcher's imagery of the tree and the fruit aimed to give the impression that scientific research is most effective in an organic, natural state where scientists work freely from the restraints of productivity.

This paper explores how Fletcher's metaphor was a way of avoiding the politically sensitive subject of 'pure' and 'applied' research while continuing to push a "basic" research policy. As Sabine Clarke has shown in a recent article, research institutions funded by the state were reluctant to use the term "pure science" because of its perceived distance from public concerns. Instead the Department of Scientific and Industrial Research used the more ambiguous term "fundamental

research" as a rhetorical device to appease both scientists and industrialists. This paper argues that Fletcher's metaphor was intended to work along similar lines. The idea of the tree and the fruit fitted both his personal ideals of "disinterested or 'pure' science" and the wider public's utilitarian values. Studying the history of the MRC, I will show how Fletcher and others did have an awareness of the distinction between 'pure' and 'applied' research, but because of the deeper cultural image the terms had adopted, attempted to find alternative ways to promote their aims.

T183-C. Modern French science: economy and institutions

Wed 24 July, 14:10–15:40 ▪ Uni Place 4.205

Chair: Peter REED | Independent Researcher, United Kingdom

Anne-Sophie GODFROY | Université Paris Sorbonne , France

Les normaliennes de la rue d'Ulm between 1910 and 1939: who and why?

Between 1910 and 1939, 44 women students entered the Ecole Normale Supérieure located rue d'Ulm in Paris, transgressing the fact it was a boys' school. The girls were supposed to study at the girls' Ecole Normale Supérieure de Sèvres. In 1939, as Sèvres was reformed and supposed to offer the same curriculum as Ulm, the administration considered there was no more reasons to allow women to transgress the rule. Through the study of their biographies, we will present their portraits, motivations and the different career profiles they experienced: few dropped out of academic life because of death, illness, persecution during WWII or personal choice. Among those who stayed in the academia, five profiles may be identified: the "stars" who had a brilliant careers in higher education, published a lot, received prizes and recognition, as Jacqueline de Romilly or Marie-Louise Dubreil-Jacotin, the successful academics who made a decent career in higher education and research, the professors who focused on teaching in preparatory classes, the disappointing careers in secondary schools, and the complete outsiders. Beyond personal trajectories, we will try to identify the internal and external factors that influenced their career profile: self motivation, family connections and double careers in the academia, good support from directors and gate-keepers, war, period of time and overall cultural climate, administrative regulations, forced migrations because of double careers, etc. In this paper, we mainly used the sources left by the alumni association, especially testimonies about the first women students in the school and death notices, when they exist. This material provides biographical data, and in addition, information on the way they are perceived by the community, it mixes personal and academic life. The author, the style and the time of the notice, right after the death or a long time after or never, are also interesting indications. We completed this material by additional testimonies and biographical data, plus the book by Jacqueline de Romilly, relating her mother's life (and indirectly hers) and Simone de Beauvoir's autobiographical "La Force de l'Age" to reconstitute a part of the climate of this period. We also made some comparisons with the careers issues experienced by women trained at the Ecole Normale Supérieure de Sèvres.

Andrew BUTRICA | Independent Scholar, United States

Jean-Baptiste Dumas, applied science, and emergent bourgeois culture

The historical literature on Jean-Baptiste Dumas has scrutinized his contributions to chemistry and chemical education and, to a far lesser degree, his political career after the Revolution of 1848. His cultivation of science-based, especially chemical, industry has received scant attention, yet for four decades he was president of the Société

d'Encouragement pour l'Industrie Nationale, founded in Paris in 1801 to improve industry through the application of science.

This talk casts the applied science of Dumas at the Société d'Encouragement within the context of an emerging bourgeois culture of paternalism and consumption. Dumas literally changed the society's history and erected its present headquarters to transform it into a bourgeois institution with funding from industry. Through the society, he created a series of paternalistic foundations to aid ill, injured, impoverished, and elderly workers in various industries again with business backing. These prefigured the worker legislation introduced under the Third Republic.

Dumas changed the course of the Société d'Encouragement, which originally fostered industries and innovations that served the goals of national industrial policy as defined by the Interior Ministry. His reinvented society favored bourgeois consumption and taste with consumer goods whose manufacture rested on an alliance of science and practice.

I follow the definition of "French bourgeoisie" framed by Whitney Walton who defines the bourgeoisie in terms of consumer tastes and practices. She shows that their values and habits upheld a social order (that included the artisan class) that the bourgeoisie aspired to dominate. Walton also discusses taste and consumption in terms of production methods (mechanized versus hand manufacture).

I argue that the industries given pride of place by the society reflected the tastes and consumption patterns of the bourgeoisie. Stearic acid industries, based on the chemistry of Chevreul, made candles, soaps, and perfumes. Silver and gold electroplating, started by Christofle and expanded through the society's efforts, also catered to bourgeois tastes.

Sonia Regina TONETTO | Pontificia Universidade Católica de São Paulo-PUC/SP, Brazil

Maria Helena ROXO BELTRAN | Pontificia Universidade Católica de São Paulo, Brazil

La Coopérative de Mme Curie: une proposition de savants pour l'éducation de base

Ce travail a pour but présenter une brève étude sur l'enseignement français à la fin du XIXe siècle et au début du XXe siècle, en particulier dans la "Coopérative de Mme Curie" qui a été ouverte entre 1907 et 1908, avec la collaboration d'autres savants. Les cours étaient donnés dans les laboratoires, les maisons des professeurs, les musées et d'autres lieux à Paris.

C'est le début d'une recherche qui vise à faire une analyse interne de l'éducation des écoles françaises, de la législation et de la réforme de 1902, relative à la structure interne de l'éducation de la Coopérative de Mme Curie, à travers les cours donnés par les savants Jean Perrin et Mme Curie. En ce qui concerne les idées de l'éducation de Paul Langevin et la compréhension des propositions pédagogiques mises en pratique dans la coopérative il faut étudier la société concernée dans la coopérative, les savants et les enseignants, y compris la proposition d'ouverture de la coopérative.

Comme montré sur un manuscrit récemment découvert, Mme Curie a donné des cours de physique aux élèves, de 7 à 13 ans, sur les propriétés de l'air, abordant la notion de densité et la fabrication d'un baromètre. D'ailleurs, ces étudiants faisaient des calculs algébriques, connaissaient l'histoire de France et visitaient les musées. Les élèves ont eu des cours d'anglais et d'allemand, y compris l'étude de chansons et de poèmes.

En outre, à partir de l'analyse d'autres documents inédits, nous pouvons observer le travail conjoint des professeurs dans la coopérative, ayant pour but la réflexion, le questionnement, la pratique et l'assimilation de ces connaissances par les élèves.

Dans les comités de l'éducation de cette époque-là à Paris circulaient les idées du philosophe Auguste Comte. En 1902 il y a eu la réforme de l'éducation en France. Les officiels ont présenté une proposition

d'enseignement à partir de leçons pratiques pour la compréhension des phénomènes naturels et la préparation du baccalauréat.

Etant donné que les matières enseignées dans la coopérative ont été celles abordées lors du comité pour la réforme de l'éducation en 1902, la coopérative a réussi à montrer qu'il était possible de développer l'esprit humain et l'usage du raisonnement depuis l'enseignement primaire.

T184. International organisations in twentieth-century science, technology and medicine

Sat 27 July, 11:00–12:30 • Uni Place 2.218

Chair: Helge KRAGH | Aarhus University, Denmark

Antony ADLER | University of Washington, United States

'Under one roof': science and the making of a 'Pacific World' during the interwar period

Antony Adler's paper examines how an attention to the history of science can help us better understand the making of a "Pacific World" during the early twentieth century. He argues that the rhetoric of science, in conjunction with internationalist movements of the interwar period, played a crucial role in shaping how the Pacific was imagined and described by inhabitants of the Pacific region and by scientists who sought to conduct systematic, large-scale, research in the Pacific basin. This paper argues that science helped cement a view of the Pacific region as a unified "world."

Natalia NIÑO | University of Edinburgh, United Kingdom

The standard child: understanding WHO growth standards

Child growth reference charts have been used since the 1960s to assess development, implement nutritional surveillance, and compare different population groups. In 2006, a pivotal moment occurred in the history of anthropometry and nutritional assessment. The World Health Organization (WHO) released new growth charts for international comparison after thirty years of having promoted the use of charts developed by the Centers for Disease Control (CDC) and US National Center for Health Statistics (NCHS). According to the WHO, these charts indicate how children should grow for the best health outcome in contrast to the NCHS/CDC charts that indicated how the average child grows. This shift from a descriptive to a prescriptive—and rather normative—approach allowed the WHO to state that all children in the world have the potential to grow and develop within the same range of height and weight; thus, suggesting that all children should develop in a specific standardized way regardless of ethnicity, socioeconomic status, and diet. From a STS perspective, this paper discusses how these standards can be understood as artifacts for human standardization and how specific values, knowledge claims and ideals regarding children's bodies and their health status are mobilized in their process of design, use, and propagation.

Nestor HERRAN | Université Pierre et Marie Curie, France

From unscare to UNSCEAR: the United Nations' Scientific Committee on the Effects of Atomic Radiation

The development of global networks of radioactivity monitoring, initially established for military surveillance by Cold War superpowers in late 1940s, had a critical turning point in mid 1950s. International controversy on the effects of atmospheric nuclear tests in human health, led the United Nations to establish a Scientific Committee on the Effects of

Atomic Radiation (UNSCEAR). The history of this institution, constituted by scientific experts from fifteen nations, shows the different diplomatic strategies and intelligence techniques put in place to control the scientific debate in the committee and its public image, as well as the interactions among scientists that led to the formation of a transnational network with pretensions of objectivity and political independence. The dynamics and networks put in place in this area may have provided a model to later institutions focusing on environmental data collection and the evaluation of its impact on the health of human populations.

T185. Science, technology and medicine and the state

Sat 27 July, 14:00–17:30 • Uni Place 2.218

T185-A. Science, medicine and the authoritarian state

Sat 27 July, 14:00–15:30 • Uni Place 2.218

Chair: Anna CARLSSON-HYSLOP | Lancaster University, United Kingdom

Manyong MOON | KAIST, Korea, Republic of

The regime's mobilization versus scientists' utilization: the development of science and technology under the Korean authoritarian regime

Under an authoritarian political regime, science and scientists are likely to be influenced both directly and indirectly by the ideology of the government. Using the expression "ideologically correct science," Mark Walker et al. (2003) presented various examples in which scientists met the demands of the government instead of resisting against the regime to uphold the neutrality or purity of science. Can this claim be equally applied to Korea, a country that has been relatively late in its pursuit of developments in science and technology?

The 1960s to 1980s was a period of dramatic change in the politics, economy, and society of Korea. The military dictator had risen to power in a coup d'état, and the authoritarian regime in the 1970s was especially coercive. During this period, however, Korea transformed from an agricultural country having a GNP per capita less than 100 dollars into an advanced industrial nation with heavy chemicals accounting for 70% of industries. The key driver behind this change was science and technology. The military regime tried to provide political justification through economic development and national security, placing the spotlight on science and technology due to its relevance to both goals. The government mobilized scientists for this purpose, and in turn, the scientists attempted to improve the poor conditions of science and technology.

Korea's science and technology have attained short-term growth based on mutual utilization between the authoritarian regime and scientists, but the negative spillover of such compressed development still has a significant influence on the Korean scientific community today. In the development of Korea's modern science and technology under an authoritarian regime, this presentation will focus on how political leaders, technocrats, and scientists changed their perception of science and technology, how such differing views were modulated, and what kind of role was played by each group in the actualization process. This case study of Korea will lead to more meaningful and in-depth discussions on the dynamics of science and politics, and the relationship between scientists and the authoritarian political regime.

Pavel VASILYEV | St. Petersburg Institute of History of the Russian Academy of Science, Russia

The Soviet government and the private provision of health care in the NEP era, 1921-1929

Soviet health care is usually associated with the so-called Semashko system (named after the first Soviet People's Commissar of Public Health), with its centralized planning and administration and the declared equal and universal access to medical and pharmaceutical services. Thus, it is often neglected that the adoption of the New Economic Policy (NEP) in 1921 actually introduced some market elements in the Soviet economy and legalized private entrepreneurship, including in the area of health care. The existence of private medicine and pharmaceutical business in Soviet Russia in the 1920s is unfortunately chronically understudied – and when mentioned, it is often presented with obsolete ideologically charged clichés – as a chaotic conglomerate of hucksters and quacks, driven only by the desire of profit. In my paper, however, I would like to present private health care in NEP Russia as an alternative to the Semashko system. This will naturally involve the investigation of the evolution of government policy towards private provision of health care and the regulation of private clinics and pharmacies, as well as the issues of financing, work motivation and profit etc. My hypothesis is that private entrepreneurship in medical and pharmaceutical spheres in early Soviet Russia was not at all doomed from the very beginning. In fact, it performed quite well in the difficult economic and administrative conditions and was able to complement state-funded health care in certain aspects. The reasons for its decline were primarily of administrative nature, since the Soviet state deliberately adopted a policy of prioritizing state institutions and pushing the private capital out of the economy by the end of the 1920s. The rhetoric that accompanied this decision actively employed the above-mentioned stereotypical images of private health care, but in fact disorderliness, incompetence and ineffectiveness remained inherent features of the government-funded medical and pharmaceutical institutions throughout the Soviet era. In my paper I would also like to pay particular attention towards comparative and transnational aspects of the problem. For example, the health care system in Weimar Germany also experienced socialization, but not to the same extent as in the Soviet Union. A comparative analysis of the status of private health care would contribute to a deeper understanding of political cooperation and knowledge transfer between the two countries in the inter-war period.

Boleslav LICHTERMAN | The Sechenov First Moscow State Medical University, Russia

The birth of a neurosurgery clinic: the Moscow Institute for Neurosurgery, 1929-1941

A 25-bed neurosurgery clinic was opened in January 1929 at the Roentgen State Institute in Moscow under directorship of Professors Nikolay Burdenko, a surgeon, and Vassily Kramer, a neurologist. A separate research neurosurgery institute was established there by a special decree of Soviet government (Sovnarkom) in October 1931 (decree №1137 from 29.10.1931). This was followed by a decree of Russian Ministry of Health (NKZ RSFSR) in January 1932 (decree №18 from 09.01.1932). Professor Burdenko was appointed the Institute director, and Dr. Efim Rossels and Prof. Kramer were his deputies. De facto the Institute was opened in Spring 1934 as Central Neurosurgery Institute. It was transferred into a separate four-storey building for 100 beds.

The aim of this presentation is to analyze surgical activity of the neurosurgery clinic and the Institute from 1929 to 1941.

It is based on archival sources from Museum of the Burdenko Neurosurgery Institute including surgical logbooks and reports on surgical activity, and published materials.

Results. According to surgical logbooks there was a more than a threefold increase in number of surgeries (there were 120 operations in 1929 (not all of them were neurosurgical) and 369 operations in 1939). The mortality rate was high. For example, there were 34 cases of acoustic neurinomas operated on for 6 years (from 1929 to 1935); 13 of

them died after surgery. Out of 28 patients operated on for cerebellar tumors only 11 survived. A detailed analysis of surgical activity from 1929 until 1941 will be provided.

Conclusions. Although postoperative mortality at the Central Institute for Neurosurgery in 1930-s was high, major surgeries for CNS tumors had been already performed there at this period.

T185-B. Postwar physical sciences

Sat 27 July, 16:00–17:30 ▪ Uni Place 2.218

Chair: Pavel VASILYEV | St. Petersburg Institute of History of the Russian Academy of Science, Russia

Chieko KOJIMA | Nihon University, Japan

Collaboration between France and the United States in the early development of FBR

French FBR (Fast Breeder Reactor) studies reached the top of the world in the middle of 1970s, although France had begun FBR research following the U.S., the U.K. and the Soviet Union. This paper demonstrates a new finding about collaboration between France and the U.S. in the beginning of French FBR research, based on documents that previous studies didn't quote.

Georges Vendryes named the father of FBR told at the author's interview that during the program of developing the first French experimental FBR Rapsodie which went in critical in January 1967, collaboration with the U.S. played an important role. It was unexpected fact if both countries developed FBR only for military purpose.

According to the classified catalogue of CEA (Commissariat à l'Energie Atomique) Archives, it includes documents which certify cooperation between France and the U.S. Although most of them are confidential that will not be to the public till 2023 unfortunately, there are some records indicating the relationship between APDA(Atomic Power Development Association) and CEA for example, among materials that we can examine since 1993. With these documents, this paper shows how France and the U.S. collaborated in detail and that this cooperation helped CEA to develop the first French FBR Rapsodie.

Daisuke KONAGAYA | Ryukoku University, Japan

Yukawa and Tomonaga: an effective combination in the flourishing of physics in postwar Japan

Hideki Yukawa (1907-1981) was awarded the Nobel Prize for Physics in 1949 for the meson theory research and became the first Nobel laureate in Japan. Sin-itiro Tomonaga (1906-1979), one of Yukawa's classmates at Kyoto Imperial University, became the second Japanese Nobel laureate for Physics in 1965 together with J. Schwinger and R. P. Feynman for their research on the renormalization method in quantum electrodynamics. In this paper, we focus on the roles of symbolic and actual leaders of "Yukawa" and "Tomonaga" in the management of physics or science systems in postwar Japan. Our special focus will be on the effective combination of the two roles as well as the two separate ones for managing physics or science in the cases of the establishment of Yukawa Hall at Kyoto University and Institute for Nuclear Study at Tokyo University. In the limelight after the Nobel Prize for Physics, the symbol "Yukawa" had the attention of Japanese people hoping the rebirth of their own country by the development of science and technology. The "Yukawa Boom" helped to facilitate the new science policy in the reconstruction of Japanese society. In that mood, "Tomonaga," who returned from the Institute for Advanced Study at Princeton, acted as a leader to make the new science system including the establishment of the new type research institutions and the future policy on nuclear sciences. Uniting the roles "Yukawa" and "Tomonaga," the two central scientists could make an effective management of physics or science policies in postwar Japan.

Sam ROBINSON | University of Manchester, United Kingdom

Close quarters: scientific culture onboard research ships

This paper will examine the growth of specific scientific maritime cultures onboard research ships during the twentieth century. In examining these unusual fieldwork spaces, this paper will chart the expansion of an oceanographic community and their interactions with the ships in which they carried out their research. Creating within their ships a space that was international, whilst remaining national, often thousands of miles from their homeports. These charged spaces forced scientist to work and live in extremely close proximity to one another for extend periods. This paper will argue that the oceanographic research ship and the Antarctic research station constitute a unique space for science. Using British case studies this paper will show how research ships changed from military spaces, (where the scientists were invited to enter to undertake their work) into spaces controlled and managed by the scientists themselves. The transformation from admiralty to Institute to research council control, allowed for the evolution of a scientific maritime culture. However as will be shown this conversion from military to civilian scientific culture was fraught conflict and the difficult adaptation of maritime traditions and the creation of new ones.

T186. Ecology, conservation, environment

Wed 24 July, 14:00–15:30 ▪ Uni Place 4.213

Chair: Sabine CLARKE | University of York, United Kingdom

Milena WAZECK | University of East Anglia, United Kingdom

Gone with the wind? Tall smokestacks, transboundary air pollution and US acid rain politics in the 1980s

- Acid rain emerged as a major environmental problem in the 1970s. When tall smokestacks were invented in the mid-20th century, sulfur dioxide (SO₂) and nitrogen oxide (NO_x) emissions from the combustion of fossil fuels were dispersed over broad areas, crossed national boundaries and affected areas far away from industrialized regions. The question of how emissions of specific sources are related to acid deposition at specific sites (source-receptor relationships) was at the intersection of basic research, modeling, and U.S. policy making in the 1980s. Are source-receptor relationships linear, so that a reduction of emissions at a specific source leads to a proportionate reduction of acid deposition in a specific area? Scientists faced high uncertainty related to atmospheric chemical reactions and their effect on source-receptor relationships. At the same time, source-receptor relationships became the center of the heated political debate on U.S. acid rain regulation during the Reagan administration. Why did scientists disagree about linearity? How did they cope with the political context of their debate?

My talk analyzes how U.S. scientists evaluated source-receptor relationships during the 1980s. I show that the scientific controversy about source-receptor relationships was shaped by disciplinary differences between atmospheric chemistry and ecosystem sciences, and I point out the ways in which scientists attempted to draw boundaries between the scientific and the regulatory debate about the linearity of source-receptor relationships.

Cheryl KNOTT | University of Arizona, United States

The network of print and the American environmental movement of the 1960s

Stewart Lee Udall, Secretary of the U.S. Department of the Interior under Presidents Kennedy and Johnson, in 1963 published *The Quiet Crisis*, a book that provided a history of the American conservation movement, discussed the degradation of the nation's natural resources, and called

for more responsible stewardship in the future. Issued the year after Rachel Carson's *Silent Spring*, it became a New York Times bestseller widely reviewed in the popular press and in scientific journals. Most of the book drew on Udall's reading of history and memoir, but the penultimate chapter, titled "Conservation and the Future," relied on seven reports published in 1962 by the Committee on Natural Resources of the National Research Council-National Academy of Sciences at President Kennedy's request and on a massive independent study produced by the Resources for the Future think tank. Udall concluded that science and technology were positive forces for resource conservation, an assertion he later regretted when, as an attorney in private practice, he litigated cases seeking compensation from the government for the harm caused to individuals by nuclear bomb testing fallout and uranium mining. Historian Byron Pearson has characterized Udall's tenure at Interior as a period of pragmatic political deal-making with the U.S. Congress that relied more on rhetoric than on scientific and technical data (*Still the Wild River Runs*, 2002). In this paper, I will evaluate the ways in which Udall interpreted and used the National Academy of Sciences and Resources for the Future information in *The Quiet Crisis* in an effort to begin to understand the network of print that influenced American environmental policy of the 1960s.

Simona CIOTLAUS | University of Bucarest, Romania

The latest objects on the conservation scene: fossils, subsoils, landscapes and the pressing politics of knowledge production and circulation posed anew

In recent decades a growing skepticism over the workings of nature conservation activities paralleled the world-wide expansion of protected areas. Taking the example of the 'Tara Hategului Dinosaurs Geopark' in Romania, the presentation discusses the emergence and circulation of palaeontological knowledge about the 70-million old Hateg Island by looking at the relationships between people, things, classification systems, heritage protection laws and "best practices" of conservation management. What can otherwise be understood as a timely transformative process that substitutes a particular understanding of subsoil and landscape for one geared towards conservation is mapped here as a convoluted trajectory of a boundary object. Together with inscription activities that turn and stabilize the stony matter into visible epistemic objects, the efforts of conservation practitioners to protect geodiversity in this area translates the materialized deep time of the 'Island' in order to co-interest other entities, like international bodies, universities, local administrations, various profit and non-profit organization. In this sense, rescaling the 'Hateg Island' brings to foreground both what these translations make visible and their simultaneous erasure of work that is deemed non-scientific. Instead of posing the conventional questions of ineffective management, more attention should be given to the naturalization of categories in an information infrastructure such as the International Union for the Conservation of Nature (IUCN). It is crucial to see that in their multiplicity, subsoils and landscapes are not only natural objects difficult to classify in clear-cut categories, but the geoconservation work also produces them as economic and political commodities.

James BERGMAN | Harvard University, United States

From growing crops to growing data: the Soil Conservation Service, the Works Progress Administration, and labor relations in climatology in New Deal America

In 1936 and 1937, the Section on Climatic and Physiographic Studies in the Soil Conservation Service initiated a microclimatology project in central Oklahoma that employed 200 farmers across three counties to take weather observations every half hour between 7am and 7pm. From that data, the project prepared 120 to 200 maps per day. As described by the head of the section, C.W. Thornthwaite, the project made possible "an intimate portrayal of the life of a storm, to follow in detail the changes

in wind, temperature, relative humidity, and cloudiness of its career." Although the benefits of the project to climatology were widely touted, the project was undertaken as a relief effort for farmers affected by persistent drought and soil erosion—i.e., the "Dust Bowl"—over the previous three years. In this paper, I will examine the organization of labor in the project—the selection of observers, the observation procedures, and efforts to explain to the observers the climatological conclusions resulting from their work—in order to understand the manner in which the changing nature of work, from agricultural to scientific, engendered a changing relationship to the land and the climate. I will argue that the practices of tracking of a rainstorm's "career" and "life history" were intimately to the practices of tracking population migration and land use planning during the New Deal.

T190. Literary approaches in the history of science, technology and medicine

Wed 24 July, 09:00–12:30 • Uni Place 2.218

T190-A. Literary approaches

Wed 24 July, 09:00–10:30 • Uni Place 2.218

Chair: Melanie KEENE | Homerton College, University of Cambridge, United Kingdom

Benjamin MITCHELL | York University, Canada

When romance meets sensation: the trans-Atlantic collision of Edgar Allan Poe's *Eureka: a Prose Poem* and Robert Chambers' *Vestiges of the Natural History of Creation*

In 1848 the American writer Edgar Allan Poe went into the publisher George P. Putnam's office on Broadway and told him that as of that day he could abandon all of his other projects and dedicate his entire business to the production and distribution of Poe's newest work: *Eureka: A Prose Poem*. The work was to be his *magnum opus*, beside which "Newton's discovery of gravitation was a mere incident". It would revolutionize the way that humanity understood its place in the world, and as such an initial print run of fifty thousand copies *may* have been sufficient.

There is no comparable story surrounding Robert Chambers' 1844 publication of *Vestiges of the Natural History of Creation*. Yet James Secord has described it as the key work responsible for bringing an "evolutionary vision of the universe into the heart of everyday life" with its widespread popularity and influence. In its first print run Poe had difficulty selling five hundred copies of his masterpiece, and his publisher concluded that: "It has never, apparently, caused any profound interest either to popular or scientific readers". Chambers' work ran to twelve editions at around twenty nine thousand copies. Insofar as it laid the groundwork for the acceptance of the evolutionary theories of the latter half of the nineteenth century, it could be said that *Vestiges*, rather than *Eureka* accomplished what Poe had claimed for himself. Charles Darwin's tombstone in Westminster Abbey, resting just a few meters away from the exalted monument to Isaac Newton, would seem to corroborate this account.

Yet however dissimilar, there was something in Poe's *Eureka* that caused contemporary commentators to link the two works together in the popular press. Here, the social circumstances and posturing of the two authors helps us make sense of this puzzling relationship. While coming from remarkably similar professional backgrounds, Chambers' anonymity and appeals to socially acceptable sources of authority allowed him to win the hearts of his bourgeoisie audience. Poe had no

such support. Instead, he parodied and criticized the very foundations of scientific discourse, and opted for a pantheistic theological underpinning to his cosmology, which flew in the face of all but the most radical of artistic and moral sentiments.

Andrea CANDELA | Università degli Studi dell'Insubria (Varese-Como, Italy), Italy

The Radium Terrors: popular science and science fiction on radioactive metals before the Bomb

At the beginning of the XX century, the collective imagination was fascinated by the discovery of radium (1898-1903). The new metal revealed great 'virtues' showing potential and interesting therapeutic applications. Different scientists and scholars, during their popular lectures, also suggested the possible use of the radioactive element for energy production. At the same time, they didn't hide some risky military consequences, in fact radium could have been exploited to create terrible weapons. In the first decade of the century, the scientific imaginary on radioactivity was supported by performances, public lectures held by eccentric speakers, periodicals and newspapers talking about marvellous, but ambiguous, power of the weird substance. Radium could have been useful against cholera, typhus and tuberculosis but, on the other side, it could have caused considerable burns on the body, as the research of Pierre and Marie Curie had already demonstrated. Public opinion was fascinated and frightened by journals, newspapers, comics and, last but not least, statements of scientists, which used a rich vocabulary based on a long and well-established tradition inspired by religion, spiritualism and magic knowledge. Such expressions as *mysterious emanations*, *invisible messengers*, *shadows of the fatal fading of the body*, *magic elements*, *wonderful care*, *fountains of youth* and *gold of the alchemists*, were very frequent on Sunday supplements of the main European newspapers. The ambiguous power of radioactive substances exerted a great influence on several science writers and science-fiction novelists. As the likelihood of war fell over Europe in 1914, Herbert G. Wells retreated in Switzerland, where he wrote an antiwar 'scientific romance' entitled *The World Set Free* (written in 1913, and published in 1914). The novel was quite a "jumble of *Well's political ideas*" (Zoellner, 2009). It was dedicated to Frederick Soddy and inspired by his popular writing on radium: *The Interpretation of Radium* (1909). The plot spans thousands of years and revolves around a main topic: an element called *Carolinum*, a fictional stand-in for uranium. Without any claim of completeness, the paper will explore some significant science-fiction novels published during the first decades of the Twentieth century, trying to establish the relationship with the emergence of a public opinion on radioactivity before the 'age of the Atomic Bomb'.

Ester BOIXEREU | IGME, Spain

Geology in Spanish Renaissance literature: Gonzalo Fernández de Oviedo (1478- 1557) and the Masaya volcano (Nicaragua)

During the Renaissance, the Spanish Voyages of Discovery lead to a major change in world view and imaging of the Earth. Nevertheless, the contribution of Spanish discoveries to geology during the Renaissance has not been sufficiently studied. In the main literary work of Gonzalo Fernandez de Oviedo (1478 –1557): "Historia General y Natural de las Indias" there are numerous references to the Natural Sciences and very specifically to geological phenomena, as are the matching coasts between America and Africa, earthquakes, mineral deposits, oil fields, and volcanoes. In this paper we present the description and interpretation of volcanic phenomena from his description of Masaya volcano in Nicaragua. Oviedo reached the summit of the volcano in 1529 when he was in eruption. A narrative of the expedition and his observations can be found in the third volume of his Natural History. In the manuscript copy, made by Antonio Gasco, in 1565, shortly after the death of the author, four pictures of Masaya volcano are included. From these, one is a map of the volcano. The descriptions of Gonzalo

Fernandez de Oviedo were detailed enough to deduce a hawaiian-type (lava lake) eruption. This is the first known description of a volcanic phenomenon in the Renaissance after Plinio.

This presentation is based on work co-authored by Carlos Villaseca.

Barbara MOHR | Museum of Natural History, Berlin, Germany
Annette B. VOGT | MPI for the History of Science, Berlin, Germany

The popularization of geosciences in literature: the case of children's and youths' books in Germany in the nineteenth and early-twentieth centuries

Whereas dinosaur books are today extremely popular and produced for almost all social groups at different scientific levels and age groups, this type of popularization was less common in Germany at the end of the 19th and beginning of 20th Century. During the 19th Century geology and palaeontology as topics for children books were relatively rare in Germany, compared with books on biology, or compared with Anglo-Saxon literature. Geosciences were not always neglected, sometimes just interwoven with other themes dealing with exotic countries, wild animals and humans of different cultures. One of the very first well illustrated examples of such literature was F. J. J. Bertuch's (1747-1822) "Bilder aus fremden Ländern", published in several volumes (1790 - 1822), where among many scientific topics the emergence of new volcanic islands and other geologic phenomena were thematized. Another example is the work of the mathematician and physician J. H. M. von Poppe (1776-1854) who started in 1822 to publish a series of popular books on astronomy, beginning with a volume on mathematical aspects of the earth, and later on the other planets. The field of paleontology, however, was still more or less neglected, although from the second half of the 19th Century popular books on geology for adults were published with great success e.g. by Bernhard von Cotta (1808-1879): "Geologische Bilder" (1852). We describe this process of popularization of geosciences from different perspectives: the various genres of literature (books, magazines and journals, like "Die Gartenlaube"), the different topics in these publications, the sociology of the authors (between amateurs and professionals), and the role women played. One of the female authors was Clementine Helm (1825-1896), married to the director of the geoscience section of the Museum of Natural History in Berlin. She published several youth books, where she incorporated science into a book genre ("Backfischroman" - novels especially written for adolescent girls). She was, it seems, also the first novelist who included in one of her slightly autobiographic books Darwin's theory on evolution (1877).

T190-B. Literary sources in the history of science, technology and medicine

Wed 24 July, 11:00–12:30 ▪ Uni Place 2.218

Chair: Ludmilla JORDANOVA | King's College London, United Kingdom

Elena ZANONI | University of Verona, Italy

The Beautiful Country by Antonio Stoppani and the popularisation of science in Risorgimental Italy

My paper will explore the contribution offered by Antonio Stoppani (1824-1891) to the popularisation of geology by focusing attention on his most successful work, *The Beautiful Country (Il bel Paese)*, published in 1876. Stoppani was primarily a geologist and palaeontologist, but, as a catholic priest and patriot, he was highly aware that science ought to be taught and popularised at all social levels. Although his first contributions were specialist palaeontological and geological works, his attention to

the field of science popularisation emerged during the Sixties with the publication of the *Course of Geology*, a manual derived from his courses for engineering students at the Polytechnic Institute in Milan. The *Course* was the first Italian manual devoted to earth sciences and it had the credit to make geology an «almost popular science» (A. M. Cornelio, *Vita di Antonio Stoppani*, Torino, UTET, 1898, p. 121). Stoppani's fame, however, is mainly associated with *The Beautiful Country*, a piece of work that highlights his accomplishments as a science populariser and contributed to the process of the Italian *Risorgimento*. Indeed, this book spread knowledge of the Italian peninsula – in terms of its physical, geographical and geological aspects - throughout the new Italian State. However, Stoppani's book did not reap such extraordinary success in Italy purely because of its contents. In fact, its publishing triumph has textual reasons such as a strong constant use of orality, a form of dialogue that follows the traditional catechetical model, connections to literature for children, odeporic literature, guidebooks, didactic literature and extracurricular literature. On one hand the book takes shape as an adventure novel through the story of the naturalist uncle's travels and experiences, on the other hand it serves as a little encyclopaedia by virtue of its numerous digressions moving from the field of physics to chemistry, and from zoology and palaeontology to history, morality and religion. Thanks to its rhetoric as well as its content, *The Beautiful Country* contributed to filling a literary gap in a culture that had shown little insight into geological-geographical issues.

Moema VERGARA | Museu de Astronomia e Ciências Afins, Brazil

Franz Keller-Leuzinger: text and image in the nineteenth-century Brazilian Amazon

Franz Keller, designer, cartographer, engineer and painter and arrived in Brazil in 1858. He became Keller-Leuzinger by marrying the daughter of a George Leuzinger in 1867, very known German typographer who lived in Rio de Janeiro. That same year he and his father were tasked by the Brazilian Imperial government to make a survey of the rivers near to Bolivia after a Diplomatic Settlement between the two countries. This voyage was recorded in the book *Vom Amazon und Madeira* of 1874, published in Germany, with 68 engravings and was reported in a series of illustrated magazines in Brazil and worldwide. This book was a very interesting ethnography with reports of the geography and social conditions of the Brazilian Amazon. This paper aims to systematize the information on the main work of Franz Keller-Leuzinger, with the primary focus on the interplay between text and image, and their reception in Brazil. The French magazine *Le Tour du Monde* also published a lengthy article, in 1874, translated by J. Gourdault, with 23 of the original woodcuts. In France, this article had some impact and influenced the novel *La Jangada*, 1881, of Jules Verne. In Brazil, the details of this trip mainly circulated in magazines such as *Ilustração Brasileira* whose editor was Henrique Fleiuss. The narrative was told in seven illustrated articles from July 1876 to May 1877. The beauty and eloquence of the images ensures the circulation of the works of Keller-Leuzinger until today. And produces an effect that deserves to be studied: the dynamic relationship between text and image in communicating science to the public.

Nataliia VOLOSHKOVA | Donetsk National Medical University, Ukraine

The crossroads of literature and medicine: T Smollett in the history of naval medicine in the eighteenth century

In the first half of the 18th century Britain was on her way to becoming the most powerful naval state. In the history of medicine this period was characterized by extremely high morbidity and mortality rates in the Navy. Naval medicine as separate branch of medical science had not formed yet. The medical treatises concerning the organization of medical service of the British seamen, specific naval diseases and their treatment were few and out of date.

This paper will explore the significance of the novel "The Adventures of Roderick Random" (1748) written by the well-known British writer Tobias Smollett (1721-1771), who was the first to address a number of significant issues which later became the subject of great attention of the prominent naval physicians.

The paper will focus on so-called naval chapters that can be considered a kind of pamphlet on the state of medicine in the Navy. The principle aim of the paper is to analyze the ideas of the writer who himself had served as surgeon's mate and the ideas of outstanding physicians of his age, compare them and prove that the naval chapters present a reliable source in the history of social and naval medicine in Britain.

The point I argue in this paper is that the naval chapters were an original contribution to the process of formation of naval medicine in the 18th century. The case of Smollett is a bright example of how the personality of the enlightened man of letters with medical education and experience, his progressive ideas and great wish to witness the changes in the Navy obtained the recognition of the professional medical circles, drew the public attention to the existing problems and prepared the ground for further positive changes in the health of the Navy.

Juan Maria FORNÉS | Instituto Geológico y Minero de España, Spain

La percepción de los humedales en la literatura española

Los humedales son complejos ecosistemas cuya importancia ha ido aumentando en tiempos recientes (Convención Ramsar de 1971). Sin embargo, la percepción que la sociedad ha tenido de los humedales ha ido cambiando a lo largo del tiempo, como puede comprobarse a través de famosas obras de literatura. La lectura de esos libros pone de manifiesto la percepción que se ha tenido de los humedales a lo largo de los siglos: zonas peligrosas, origen de enfermedades e infecciones, áreas de esparcimiento y recreación, lugares de refugio de animales, espacios de caza y pesca, zonas improductivas que tenían que reconvertirse para la agricultura, áreas singulares rodeadas de misterio, etc.

En la literatura española son abundantes las referencias a los humedales. Así, en la obra más famosa de la literatura española, "Don Quijote de La Mancha", se describe con detalle el origen de las Lagunas de Ruidera. Anteriormente, en la Edad Media, importantes escritores españoles citan algunos de estos ecosistemas como Las Tablas de Daimiel, la Laguna de Sanabria, etc. Este último humedal ha sido también relevante en el folklore español.

Este trabajo descubre la diferente percepción social española sobre los humedales a través de la historia, especialmente en la Edad Moderna y Contemporánea, desde el punto de vista de las grandes obras de su literatura. Así, se han estudiado algunos escritores del Siglo de Oro Español (siglos XVI y XVII), así como otros pertenecientes al Romanticismo y Realismo (siglo XIX). A finales del siglo XIX, surge un nuevo florecer de la literatura española que cristaliza en la denominada "Generación del 98", que para muchos expertos constituye una segunda edad de oro. Ya en el siglo XX se han analizado obras de literatura de autores de la llamada "Generación del 27" y de otros más recientes.

The perception of wetlands in Spanish literature

Wetlands are complex ecosystems which importance have increased in recent times (for instance, Ramsar Convention in 1971). However, the perception that society has had of wetlands has changed along the time, and can be traced back by considering how they have been perceived through the most famous literature works. By reading these books, one can understand the perception of wetlands along the centuries: hazardous areas, sources of infections and sickness, places of leisure and recreation, refuge areas of

wildlife, places for fishing and hunting, unproductive areas that had to be gained for agriculture, unique mystery places, etc.

References to wetlands are abundant in Spanish literature. For example, in the most famous work of Spanish literature, *Don Quijote de La Mancha*, there is an extensive description of the origin of the *Lagunas de Ruidera*. Earlier, in the Middle Ages, important Spanish writers quoted some of these ecosystems as *Las Tablas de Daimiel*, *Laguna de Sanabria*, etc. This last wetland has also a great reception in Spanish folklore.

This study discovers the different Spanish social perception about wetlands throughout the history, especially in the Modern and Contemporary Ages, from the point of view of the great works of Spanish literature. Thus, we have studied some writers that belong to the Spanish Gold Century (16th and 17th centuries), as well as others belonging to the Romantic period and Realistic one. At the end of the 19th century, there is a new boom of Spanish literature named “Generation of the 98”, for many experts considered as a second golden age. In the 20th century, some literary works of the so-called “Generation of 27” and other most recent writers, have been analysed.

T191. Science and art

Fri 26 July, 11:00–12:30 • Roscoe 1.009

Chair: **Boris JARDINE** | Science Museum, United Kingdom

Camilla RØSTVIK | University of Manchester, United Kingdom

At the edge of their universe: art and science at CERN

Hugely complex issues of representation lie at the heart of communication in modern science, whether person-to-person or at the interface of humans and machines. Increasingly artists are being brought in to help science communicate its message and importance. At The European Organization for Nuclear Research (CERN) the Collide@CERN project is the international organization's first large scale venture into the world of art. Who is better prepared to interpret the scientific art that such projects produce? The scientist, the art historian, the science historian or the artist? What questions of taste and connoisseurship does this new trend imply? And why do scientific budgets now include ‘creative aims’? Through examining this large-scale, expensive and prestigious science organisation's flirtation with the arts, this paper will reflect on how the merge of art and science in these spaces create contemporary hierarchies in art and science histories.

Hilary DOMUSH | Chemical Heritage Foundation, United States

Fundamental or applied? Sensing scientific understandings of climate change research

Sensing Change, an art installation based upon real, forecasted, and imagined changes in the local environment of the Philadelphia region, presents innovative methods of experiencing a local environment. Additionally, this exhibit connects those local concerns to a global change, while exploring the role of art in science communication. As part of Sensing Change the Chemical Heritage Foundation conducted life-story oral histories with atmospheric scientists, who devote their research lives to better understanding the complexities of particulate matter in the air, air quality, and emissions as each pertains to climate change. These scientists, literally, live and breathe their research. Encouraged to discuss themes surrounding particulate matter in the air, air quality, and emissions, the scientists also explored the complexities

of visualizing unseen data for both scientists and the public. At its core, the atmospheric science oral histories explore fundamental scientific concepts, but, crucially, they foster a deeper understanding of the scientific lives underlying that science. These oral history interviews illuminate how and why these scientists conduct research on the environment and the ways in which their scientific understandings are impacted, modified, and changed by the public discussions surrounding air quality and climate change. Most importantly, the oral history discussions highlight the different ways in which scientists understand their fundamental research as having applied purposes. Many of the scientists interviewed feel a responsibility and a need to conduct research with an application; yet, they are not always the ones directly affecting policy or representing the science in front of the public. How do scientists at the forefront of our understanding about air quality and climate change understand the balance between fundamental and applied research.

Sarah HUNTER-LASCOSKIE | Chemical Heritage Foundation, United States

The art and science of sensing change

The Chemical Heritage Foundation's [CHF] upcoming initiative, Sensing Change, an art exhibition that presents innovative methods of experiencing a local environment, connects local concerns to a global change and explores the role of art in science communication. CHF staff have begun exploring methodology by which several important narratives and discussions about the history of science, climate change, and art can be elucidated. Of specific interest are the voices of the artists themselves: their discussions of their own methods and research, their use of science and relationship with the scientific community, and their role in communicating science to the public. Interviews conducted by CHF staff with these artists in their own studios and/or environments have revealed the potential for a more symbiotic relationship between art and science and has exposed the ways in which these communities are already interacting. And in partnership with a complement oral history project (with leading atmospheric scientists), the artistic process can be viewed as a research-based, scientific method in and of itself. These conversations are part of a historical trend that can be traced at CHF, a trajectory of scientists and citizens creating and modifying instrumentation and methodology to sense change in the world around them. From water testing kits to spectrometers that help determine important facts about air quality, instrumentation within the CHF collection puts the conversation and work of both artists and scientists into an already rich history of environmental science and investigation, as well as scientific communication. The initiative's goals—to communicate science, art, history, and the interactions and intersections of those three fields—is a daunting public history project. While the scientific data and superstorms like the recent Hurricane Sandy put concrete facts in the public eye, climate change is a controversial topic; what's more, art's intervention in climate change discourse is still evolving. How might we as historians tackle a narrative that is currently developing? What is our best methodology for starting conversation about how we view the world around us—and what we should do about it? How can we center current discourse in a historic framework? The Sensing Change project is revealing the ways in which our relationship with discovering truths—sometimes uncomfortable truths—about nature is evolving, and how public history projects continue to develop into dialogue-based, interdisciplinary projects.

T192. Medicine and the media

Wed 24 July, 14:00–17:30 • Uni Place 2.218

T192-A

Wed 24 July, 14:00–15:30 • Uni Place 2.218

Chair: Simon CHAPLIN | Wellcome Library, United Kingdom

Diana GARRISI | University of Westminster, United Kingdom

Victorian wounds and scars: the skin of a flogged soldier ends up in *The Times* newspaper

On the 15th of June 1846, John Frederick White, a 27-year-old private based at the Cavalry Barracks, on Hounslow, was awarded 150 lashes for assaulting a sergeant. Twenty six days later he died. The military surgeons, after performing a post mortem examination, drew the conclusion that the soldier died from inflammation of internal organs. They denied any connection between the flogging and White's death.

The military officers were ready to bury the body when this news reached the ears of anti-flogging campaigner Thomas Wakley, coroner for Middlesex and founder of the *Lancet*. Wakley decided to hold a public inquest into the death of White to find out what was the exact correlation between the superficial lacerations caused by the flogging and the internal inflammations that occurred afterwards and caused the soldier's death.

For weeks, the observations made upon the skin of the soldier's back were reported in detail by *The Times*, inflaming the public debate on the abolishment of flogging in the army. The sensationalism was fomented by the story that a large piece of skin was cut away from the soldier's back and nowhere to be found. The aim of this paper is to demonstrate how the inquest into the death of private White, as extensively covered by *The Times*, provided a platform for discussing and promoting the knowledge of the characteristics and properties of the human skin.

The questions to be addressed are: how did the information resulted from the post mortem examinations contribute to popularize the knowledge of the skin among the paper's readers? How did *The Times* cover the mystery of the missing piece of skin? What was the role played by the skin in shaping the argumentation set by the anti-flogging supporters? What impact did the eventual intervention of dermatologist Erasmus Wilson have on the inquest's outcome?

This research argues that *The Times'* focus, during the inquiry, on the examination of the skin of John White, contributed to develop a greater understanding, among the public, of the physiological, pathological and psychological aspects of the wound caused by the whip, then, a wound still considered 'only skin-deep.'

Fiona PETTIT | Independent scholar, United Kingdom

Maternal impressions, teratology, and public knowledge in late nineteenth-century Britain

Between 1890 and 1891 the *British Medical Journal* and the *Lancet* both printed a series of letters and articles concerning the use of medical language in the lay press. These pieces reveal mixed reactions to the dissemination of medical knowledge amongst the general populace. The responses ranged from fears of medicine losing its professional prestige to amusement over the confusion and possible anxiety such articles may cause. Yet, all of these reactions reinforce the communal agreement that medicine was an elite profession which must maintain its independence from popular culture.

However, there were some debates circulating in the medical community at the end of the nineteenth century which reveal medicine's precarious relationship with popular culture. For instance, the theory of maternal impressions, that is, the notion that a severe shock or surprise experienced by a pregnant woman would leave a mark on or alter the development of her foetus, was still a contested belief in medicine at the end of the century. When presenting cases of 'monstrosity' before medical societies or reporting cases to the *Lancet* or *British Medical Journal*, many doctors would cite a particular experience had by the mother as the cause for the deformity. Some would even note their patient's attendance to a freak show. In this way, some medical practitioners shared a belief that still had currency among the general public. Indeed, the belief in maternal impressions helped many showmen

promote the performers within their freak shows. With developments in the study of embryology and teratology, the belief in maternal impressions within medicine was increasingly challenged in the late-nineteenth and early-twentieth centuries.

This paper will delve into the relationship between medicine and popular culture at the end of the nineteenth century. In particular, it will focus on the contradiction posed by the professional resistance to sharing knowledge with the population at large, yet the reluctance of some medical practitioners to move on from the popular belief in maternal impressions.

Carol-Ann FARKAS | Massachusetts College of Pharmacy and Health Sciences, United States

The expert non-expert: health and the making of knowledge in popular culture

The term "layperson" refers simply to someone who is not an expert, but the word originally meant someone not admitted to the specialized practices of a particular discipline, making those practices inherently mysterious. In contemporary culture, the historical distinction between "lay" and "expert" status still has significant effects on the average person's experience of medical knowledge, and as much as medical education programs today emphasize the importance of a provider-patient partnership, the relationship is fundamentally unequal. The layperson has no direct, privileged access to medical research: the "best" knowledge, the research and training which inform evidence-based medicine, is found in academic settings—medical schools, university libraries, professional associations—which are off limits to lay people. Both money for fees and specialized training are barriers to accessing and understanding expert knowledge.

This does not mean that lay people do not make knowledge of their own. Non-experts have access to vast amounts of medical information in popular culture: in addition to what we glean from interactions with their providers, we find health information on medically-themed television programs, wellness magazines, health information websites, and online discussion boards. From these multifarious sources, laypeople are able to construct home-made medical knowledge, which can be effective and valuable: we can educate ourselves about conditions, prevention, and treatments; a medical mystery program on tv can lead to the discovery of a previously undiagnosed condition; an online discussion thread allows contributors to share advice about negotiating the healthcare bureaucracy. These sources can also lead laypeople astray: misinformation abounds, and even when the "facts" are right, a lack of training can lead a non-expert to apply that information in inaccurate, potentially damaging ways.

In this presentation, I will analyze how non-experts make medical knowledge, focusing specifically on one example, the reader discussion forums that appear in *The New York Times'* "Health" section. I argue that medical experts must be more attentive to how non-experts work with one another to make sense of their health in these sites of shared, democratic, but undisciplined, medical knowledge—not with the goal of controlling or limiting this process, but rather to demystify it and harness its potential educational benefits.

T192-B

Wed 24 July, 16:00–17:30 ▪ Uni Place 2.218

Chair: Tim BOON | Science Museum, London, United Kingdom

Solveig JÜLICH | Stockholm University, Sweden

In the light of media: mass x-ray screenings for tuberculosis in Sweden, 1940-1970

This paper presents an ongoing research project that examines the exchange between medicine and the media during an era marked by the expansion of the Swedish welfare state. More specifically the aim of this

project is to analyse the mass x-ray screenings for tuberculosis in Sweden in the light of media development. The period of time under examination coincides with a breakthrough for 35 mm still cameras, the use of photographs in the press and in television broadcasting as well as a proliferation of propaganda and advertisements. What was the relation between medical x-ray technology and commercial media in the development of miniature x-ray photography? What media strategies were employed to mobilize the support of the citizens for the mass x-ray screenings of healthy and sick lungs? What consequences did the collaboration between medical and media actors have for the reporting about the survey to the public? How and with what effects did the chest x-rays intervene in people's everyday life? To achieve the objectives of the project a series of empirical studies are presently being conducted that draw upon a broad range of textual, visual, and audiovisual sources. Analytically the focus is partly on the convergence between medical instruments and media techniques, partly on overlapping media use, partly on institutional collaborations. The paper will end with some thoughts of how this project can contribute to historicise current discussions on mediatization as a phenomenon linked to late modern society.

Ramona A. BRAUN | University of Cambridge, United Kingdom

Organ movies: laparoscopic film production and its international audience in the 1960s

Analyzing the work of a key film maker, this paper argues that most gynaecological films of the 1960s are significantly indebted to biological cell-films produced in the 1920s on the epistemological level, constituting a form of research note book. The audience was different from public health films: experts were watching. Previously secret interior worlds of the body are the subject of films shot through the laparoscope. The optic tube inserted into the abdomen had been discovered as an exciting tool by gynaecologists in the 1950s, serving for minor operations on the tubes and ovaries and differential diagnosis of various diseases. Researching doctors switched from photography to 16 mm film as soon as their private budgets allowed. Constantly at hand in the operating theatre, the camera was quickly attached to the laparoscope in selected cases, recording the gaze into the anaesthetized woman's peritoneal cavity. Crudely edited and provided with a self-made soundtrack of scholarly commentary and classical music, the films were taken to international congresses. From 1956 onwards, the World Congresses of Fertility and Sterility featured short films about the reproductive system of humans and animals and about ways how to manipulate them. Gynaecologists, biologists, embryologists, histologists and endocrinologists attended sections dedicated to organs and functions rather than disciplines. Knowledge transfer was easy and significantly contributed to the rise of reproductive medicine. At gynaecological conferences, the manual skills for cutting and grasping instruments in the body were taught in close-up sequences. In the age of population control, surgeons around the globe were eager to learn how to apply the latest sterilization clips. In 1962, surgeon Hans Frangenheim in Cologne ventured into physiological documentary, recording human ovulation on celluloid for the first time. 'Ovulation Homo Sapiens' is an example of the ample circulation of laparoscopic films: shown at fertility conferences to an audience already acquainted with animal ovulation, this film became well known due to the aura of its pioneering nature. Its clear aesthetics also appealed to the German Institute for Scientific Film (Institut für den Wissenschaftlichen Film) who integrated the 2 minute piece into their ambitiously conceived Encyclopaedia Cinematographica, a 1,000 reel collection of 'samples of movement in the natural world', classified by species and part of the body. Laparoscopic films therefore provide a major study case for the dissemination of medical knowledge post-WWII.

Tom EWING | Virginia Tech, United States

The epidemic 'reigns and rages': telegraphic communications and information networks during the 'Russian flu,' 1889-1890

On December 25, 1889, the *Los Angeles Times* reported that the epidemic of influenza "reigns and rages" in Paris, resulting in a canceled conference of lawyers "because a majority of speakers were ill." The same article reported on the influenza in other European cities. In St. Petersburg, two-thirds of the population suffered from "the malady" and "scarcely a member of the imperial family has been free from it." In Brussels, schools were closed because one-third of children were sick. In Berlin, officials reported "no abatement of the evil." In Frankfurt, trams ceased to work because "the employees are all ill." In Vienna, many victims of influenza are "stricken with inflammation of the lungs and several of them have died."

This newspaper report on infected cities stood at the intersection of three distinct processes relevant for studies of medicine, engineering, and science. First, the medical situation changed suddenly with the outbreak of a virulent form of influenza. Second, the technological breakthrough of the telegraph and transoceanic cables allowed information to spread across long distances very quickly. Third, the public was increasingly aware of scientific discoveries, as reports of the pandemic anticipated the actual arrival of the disease. This project explores the rapid dissemination of medical understanding, the geographies of health discourse and news reporting, the authority claimed by physicians in public rhetoric, and the long-distance transmission of scientific understanding.

Both contemporaries and historians noted that the telegraph changed understanding of time and space by conveying information quickly over long distances. This study is the first to ask how the acceleration in communication shaped understanding of a disease that spread more quickly and over longer distances than any previous outbreak. Epidemiologists have begun to examine the "Russian flu" as a precursor to the more deadly "Spanish flu" of 1918. This paper makes a unique contribution by asking how telegraph networks allowed reports about the flu to precede the spread of the disease. Finally, examining newspapers from Europe, Africa, Asia, and the Americas illustrates how a worldwide network transmitted information about a global pandemic. This paper is part of a larger study of the epidemiology of information that uses digitized newspapers to trace knowledge about disease in historical contexts.

T193. Science, technology and medicine in the public sphere

Tue 23 July, 09:00–15:30 • Uni Place 2.218

T193-A. Science, technology and medicine in the public sphere

Tue 23 July, 09:00–10:30 • Uni Place 2.218

Chair: Jim SECORD | University of Cambridge, United Kingdom

K. G. VALENTE | Colgate University, United States

Disseminating and contesting the new infinite in the *Hibbert Journal*, 1900-10

Challenging ideological perspectives maintained for millennia, the mathematization of the infinite that took place in the last half of the 19th century was understandably destined to be controversial. Georg Cantor, as we know from the scholarship of Joseph Dauben and others, was preoccupied with the theological implications of this work and communicated his ideas to officials in the Catholic Church as a way of, among other things, ameliorating tensions. By the early 20th century others were prepared to assign spiritual significance to contemporary investigations into the infinite and attempted to share their convictions

with readers who first needed to be made aware of the mathematical conceptions that underpinned them.

This paper considers the dissemination and contestation of the new infinite, as it was heralded in early reports, through writing that was directed primarily at non-specialist readers. A particular source of interest is the *Hibbert Journal*, which was published in Britain from 1902 and dedicated to serving a thoughtful public by representing a multiplicity of views on religion, theology, and philosophy, including reflections on mathematical and scientific innovations. In particular, from its inaugural issue it became a conduit for the circulation of mathematical developments related to transfinite investigations, one that featured an impressive cohort of participants from England and America. Through articles and responses published in the *Hibbert Journal*, and elsewhere, we find evidence of the public dissemination of information related to the new infinite that lends itself to exploring contemporary modes of knowledge transmission not specifically tailored for experts or practitioners. Against a backdrop of continuing professionalization, work of mathematical import appearing there exposed readers to points of foundational contention associated with the new infinite, contributed to progressive discourses in theology, and engaged in a recuperative re-examination of the discipline that highlighted its humanistic relevance.

Dick VAN LENTE | Erasmus University Rotterdam, Netherlands

Explaining computers and automation to large lay audiences: the Netherlands, 1945-1970

This paper reports on research that aims to understand how complicated new technologies with purportedly transforming consequences for society, such as computers and nuclear power, were explained to the lay public during the first two post-WWII decades. In terms of the conference theme, this is an instance of science communication, which involves a transformation of knowledge to suit a wide range of non-specialists, and dissemination of this transformed knowledge. While 'computers in the Netherlands' is the case presented, the more general aim of the presentation is to discuss with other scholars similar studies carried out elsewhere, and explore possibilities of international comparisons. Because these technologies spread internationally, the ways they were understood and represented need to be understood in a transnational framework.

The paper will discuss the source base, theory and methods I have been using, as well as my first results. The source base consists of popular publications appearing regularly during the whole period, esp popular illustrated magazines and comic strips. The methods employed are a longitudinal quantitative analysis of the occurrence of these themes during this period, and a structuralistic content analysis, drawing from literary studies, which aims to identify the main patterns of narrative and counter-narrative, in which knowledge about computers was packaged. Among the findings are the occurrence of two waves of increased attention, the mid-fifties and the late sixties, each focusing on very different concerns, and a surprising overlap in the framing of the theme between these popular publications and debates among intellectuals.

TAKARABE Kae | Chubu University, Japan

The Smithsonian News Service: focusing on the work of science writer Madeleine Jacobs

Founded in 1846, the Smithsonian Institution is the world's largest museum and research complex. More than 30 years ago, the lack of public awareness about research being undertaken at the Smithsonian prompted the Office of Public Affairs to initiate a news service to enhance the visibility to the public of the Smithsonian as an important research center. This paper explores this service, a topic that appears to have been more or less neglected in former studies.

1. The Smithsonian News Service

In October of 1979, the Smithsonian News Service was established to provide a nationwide, feature story service for daily and weekly

newspapers. Every month, the service distributed a set of four stories, sometimes with illustrations and photographs, written about various research projects and activities being undertaken by the Smithsonian Institution. In the sciences, the stories described the process and benefits of research, while in the arts and history they discussed trends, perspectives and research. The service eventually became very popular.

2. Madeleine Jacobs (1946-)

The person who launched the news service is Madeleine Jacobs. She majored in chemistry and joined the Smithsonian Institution as chief science writer in 1979. In order to write science stories for the news, Jacobs actively visited Smithsonian research facilities, gained information directly from the scientists, and wrote about various activities carried out there. For example, her chosen subjects included photosynthesis as an energy system at the Radiation Biology Laboratory in Rockville, MD (December 1979); a new view of the universe from X-ray images at the Einstein Astronomical Observatory at the Harvard-Smithsonian Center for Astrophysics, Cambridge, MA (April 1981); the important role of ants in ecology at the Chesapeake Bay Center for Environmental Studies near Annapolis, MD (June 1980); and fathers in the animal kingdom at the National Zoo's Conservation and Research Center in Front Royal, VA (June 1981). Jacobs also visited Panama, the location of the Smithsonian's Tropical Research Institute and wrote many stories on tropical biology, including an exciting new world of beautiful and bizarre marine creatures (September 1984).

Jacobs traveled all over the world with Smithsonian scientists. She shared not only their scientific knowledge but also their enthusiasm for research with the public through her writing for newspapers.

Maika NAKAO | Keio University, Japan

Modern Japanese physicists and public relations: the cases of Hantaro Nagaoka and Yoshio Nishina

This paper examines how Japanese physicists came to realize the importance of engaging in public relations during the early 20th century, focusing on their statements in the popular media. In the first half of the 20th century, Japanese physics had made much progress. Outstanding scholars such as Hideki Yukawa (湯川秀樹), the first Nobel prize laureate in Japan were active in the 1930s, when Japanese saw the construction of the largest cyclotron outside the U.S. This progress was covered by newspapers and popular magazines whose articles envisioned a rosy future through scientific progress. Science articles in the mass media demanded scientists' remarks and scientists required to respond. Two main figures will be discussed and contrasted. The first is Hantaro Nagaoka (長岡半太郎), the most eminent and significant physicist among the first generation that had been trained in Japan. The second is Yoshio Nishina (仁科芳雄), who was regarded as the founding father of modern physics in Japan. Nagaoka was born in 1865. After graduating from (Tokyo) Imperial University, he studied under Ludwig Boltzmann in Germany for 3 years. He made efforts to help scientific education put down roots in Japan. He started to appear in the public media in 1905, shortly after Japanese victory in the Russo-Japanese war. He also wrote a popular science book in 1906.

Nagaoka's public statements at this time however did not catch much popular attention. Nishina was born in 1890. He studied more than 5 years at Niels Bohr's laboratory in Copenhagen. After returning to Tokyo, he founded a laboratory which was modeled after that in Copenhagen. He constructed two cyclotrons in the late 1930s. During WWII, he became a leader of the Japanese nuclear weapons research project. In the meantime, Nishina started to appeal to the public: he opened his laboratory and performed public experiments. The public were enchanted by his performances. This paper will argue that Japanese physicists gradually learned how to appeal to the public. When Japanese physicists became aware of the importance of public relations, Japan was in the process of militarization, the public sphere was formulated. A connection between physics and the war was made in the public sphere.

Different strategies of public relations reveal changes in the public status of physics and science in early 20th Japan.

T193-B. Science and religion in local contexts

Tue 23 July, 11:00–12:30 ▪ Uni Place 2.218

Chair: Roland JACKSON | The Royal Institution, United Kingdom

Scott PRINSTER | University of Wisconsin, United States

The queen dethroned? The changing role of the biblical worldview in the history of science

An important foundation in the western development of scientific knowledge has been the biblical worldview. More than simply providing the foil against which science rebelled, the accounts of nature contained in the Hebrew and Christian Scriptures coexisted with and informed the empirical exploration of nature, and the systematic study of these texts was even celebrated by some as “the Queen of the Sciences.” However, the status and authority of the biblical accounts shifted in the nineteenth century as new scientific truths came to light, and as biblical studies itself adopted an explicitly “scientific” approach. This paper will explore how both advocates and opponents of the new biblical criticism in Germany, Britain, and the United States claimed scientific status for their positions, and how their efforts helped to shift the boundaries of the legitimately “scientific.”

Francisco MALTA ROMEIRAS | University of Lisbon, Portugal

Science and social credibility: the journal *Brotéria*, 1902-2002

It is well known the Society of Jesus was involved in the teaching and practice of mathematics and astronomy in the 16th, 17th and 18th centuries in Europe and East Asia. In Portugal, from 1540 to 1759, the Jesuits developed and maintained a vast network of colleges and were responsible for the education of around 20 000 pre-university students. With the expulsion of the Order by the Marquis de Pombal (1759), the Jesuit colleges were closed and the educational system was shattered. The secularization of the educational system was accompanied by a massive political campaign in which the Jesuits were considered the major obstacle to scientific progress. This accusation of obscurantism and scientific illiteracy was largely accepted in Portugal in the 18th century and persisted throughout the 19th century. When the Jesuits returned to Portugal (1848), in order to recover its scientific and social credibility, they made scientific research a priority. Among their initiatives, they established “*Brotéria*”, a scientific journal with original research papers. Founded in 1902 by three teachers of the Jesuit college of São Fiel (Castelo Branco, Portugal), it published 400 popularization articles and more than 1300 research papers on zoology, botany, biochemistry and molecular genetics. It is one of the most significant learned and scientific journals in Portugal in the 20th century. By analyzing *Brotéria*’s publications (1902-2002), I plan to shed some light into the outer tensions and the inner desires that led a religious order to deeply engage in scientific practices in order to recover its social credibility.

Clara FLORENSA | Centre d’Estudis d’Història de la Ciència de la Universitat Autònoma de Barcelona (CEHC-UAB), Spain

Spaces for debate between science and religion during the Franco regime in Spain: the ‘Intellectual Conversations in Poblet’

From 1959 to 1961, the first three “Conversations of Intellectuals in Poblet” took place. These were organized by the “Catalonia and

Balearics Section of the Menéndez Pelayo Association”, which borrowed its name from a XIXth century Spanish writer who became a symbol of Francoist ideology and erudition. Those “Conversations” brought together religious figures and renowned scientists in the Santa Maria de Poblet Monastery, in Catalonia (Spain), with the “intention of achieving a Catholic body of doctrine and thought about science issues which presented problems of compatibility with Catholic dogma”, as they were presented in the press at the time. The very first one, in 1959, was devoted to the origin of life and the possibility of biological synthesis in the laboratory. The second one, in 1960, addressed the issue of evolution. And the third one, in 1961, dealt with the origin of man. At a time when the media offered very little coverage of the topics addressed in

these conversations, because of Franco’s regime strong control policy on the public sphere about dogma-threatening ideas, the most important personalities in religion and science created a closed space for religious-scientific debate. Who were these characters? How were such issues treated? Did they achieve any kind of consensus? To what extent science and religion modelled each other? The analysis of different kinds of sources (internal documents, specialised journals and general press) reveals three levels of communication. Although debate about those topics did not have room in the general press, the success of these meetings was reported by some of the most read newspapers in the country where the initiative was presented as new and crucial. Was it only a propagandistic success?

Jonathan WRIGHT | Queen’s university Belfast, United Kingdom

‘A kind of freemasonry where religious discourse had no place’? Religion, politics and the realities of science in mid-Victorian Belfast

In the period 1850-1875, Belfast experienced rapid urban growth, accelerating industrialisation and episodes of acute sectarian unrest. With a few short-lived exceptions, the town council remained under the control of a Tory cabal and a Protestant mercantile elite dominated the city’s associational culture. Keeping the civic politics of Belfast firmly in mind, this paper will explore the uneven political and cultural topography of the town’s scientific culture. Drawing on research conducted for the AHRC Scientific Metropolis project, it will first establish the scope of scientific activity undertaken in the town, establishing the wide range of civic societies involved in promoting science. Following this, it will turn to highlight a series of case studies or ‘moments’ which offer insights into the ways in which scientific discourse was put to work for political and religious ends. Two such case studies are provided by the meetings, hosted in Belfast in 1852 and 1874, of the British Association for the Advancement of Science (BAAS). The paper will discuss the planning for the 1852 meeting, reflecting on the political and religious makeup of the societies involved in its organisation, and will highlight an overlooked episode from the 1874 meeting – John Tyndall’s announcement of the end of the Belfast mill workers strike. In addition, the paper will investigate the short-lived history of the Belfast Working Classes Association, using it as a means to trace the emergence of a Catholic intelligentsia, and will highlight the controversy surrounding the alleged anti-Catholicism of the guidebook prepared by the Belfast Naturalists’ Field Club for the 1874 visit of the BAAS. In addressing these episodes, the paper will seek to establish the complex nature of scientific associational culture in a divided urban context, and will complicate an existing narrative which portrays Belfast’s scientific societies as neutral spaces, unaffected by the town’s political and confessional realities.

T193-C. Public cultures of nineteenth-century science

Tue 23 July, 14:00–15:30 ▪ Uni Place 2.218

Chair: Edward DAVIS | University of Cambridge, United Kingdom

Melanie KEENE | Homerton College, University of Cambridge, United Kingdom

Familiarity at work: how to learn about the solar system

Oranges and basketballs, blueberries and carriage wheels, motor cars and oil lamps, sewn samplers and even rotisserie chickens: a constellation of familiar objects has been put to work in attempts to teach the solar system over the past three hundred years. The heavens were brought down to earth as authors and educators deployed physical analogues and recruited sensory experiences to teach what was seen as a fundamental starting-point for astronomical knowledge. In this paper I shall use the solar system as a means of interrogating 'familiar science' from the mid-eighteenth to the mid-twentieth centuries. As a standard part of all introductory texts and lectures, exploring the ways in which the solar system was incarnated provides an excellent example of how the shifting contours of the familiar world were mapped onto novel scientific knowledge, in this case of the universe. Analysing how and why new objects were brought into introductory explanations, and what those objects were, elucidates how these lessons participated in debates over the place of and participants in the sciences. Moreover, it confirms that familiar analogies were only effective when they were, in fact, familiar to their audiences; an assumption put to the test, of course, by the early twentieth century, when the solar system itself became a model for the atom.

Hsiang-Fu HUANG | University College London, United Kingdom

劇場中的宇宙：大眾天文演講在十九世紀的倫敦

大眾科學演講在十九世紀初的英國已相當興盛。受通俗表演文化影響，當代的大眾科學演講常為混雜教育及娛樂的產物。許多研究文獻探討此時期的大眾科學演示，例如Altick (1978)、Hays (1983)，或最近由Fyfe and Lightman (2007) 彙編對「大眾市場中的科學」論述的諸作品。天文演講亦不例外。設置在舞台上的大型簡明式太陽系儀自十八世紀後期開始發展，並成為大眾天文演講的重心。屢被前人研究提及的著名案例為Walker家族的Eidouranian。其後在維多利亞時代的倫敦仍有許多類似的大眾天文演講。有些講師在當代頗負盛名，但今日卻對他們所知甚少。本研究探討的天文講師包括C. H. Adams (1803-1871)、George Bartley (1782-1858)、G. H. Bachhoffner (1810-1879)、John Wallis (d. 1852?)。這些講師殊異的背景及風格，以及其演講場所的差異，反映了當代天文科普的多樣性。本研究將揭示一個由科學圈外的「科學表演者」為主角的十九世紀天文科普市場。

(本論文以英語發表；this paper is presented in English.)

The universe in a cockpit: orreries, showmen and popular astronomical lectures in London, 1820-1870

Popular scientific lecturing had been flourishing in the early nineteenth-century Britain. Being influenced by the contemporary show culture, scientific lecturing to the lay audience was a sensational, sometimes bizarre, mixture of instruction and entertainment. Many studies had discussed the phenomena, such as Altick (1978) and Hays (1983), or more recently the works on 'science in the marketplace' edited by Fyfe and Lightman (2007). Astronomical lecturing was no exception. The transparent orreries, a huge type of planetariums on the stage, had been developed since the late eighteenth century and been a centrepiece of astronomical

shows. The most famous example mentioned by previous studies was the Walker family's Eidouranian. However, the Eidouranian was not the end of similar performances; there were various astronomical lectures afterwards in Victorian London. Some lecturers enjoyed popularity yet little is known about them today. The list included the independent showman C. H. Adams (1803-1871), a professional actor George Bartley (1782-1858), the Royal Polytechnic Institution's G. H. Bachhoffner (1810-1879), and John Wallis (d. 1852?) who lectured in many mechanics' institutes. The different backgrounds and characters of these lecturers, along with the diverse spaces in which the activities took place, reflect a broad spectrum of the contemporary popular astronomy. My study will show a nineteenth-century arena of astronomical popularization wherein the popularizers were beyond the circle of professional scientists.

Robert G W ANDERSON | Clare Hall, Cambridge, United Kingdom

Learning from things: workers and mechanics institutes, exhibitions and the public museum movement

Before the early 19th century, workers had limited interaction with material culture outside their immediate homes and workplaces. The establishment of mechanics institutes, lyceums and schools of arts from the 1820s significantly broadened possibilities to experience exotic material. Through lecture courses they could come into contact with collections of natural history, minerals, philosophical instruments and sometimes art productions. Many of the institutes established their own museums and set up temporary exhibitions on a regular basis. From mid-century came the international exhibitions which workers attended in large numbers (some disgruntled artisans, feeling that they had not received the credit they deserved for creating the objects displayed, got together and established exhibitions of their own). Public museums were established, often with clear educational agendas, though access to them was not always straightforward for working people, with locations and opening hours often acting as disincentives. In fact, these new museums frequently led to the decline of the mechanics museums. However, there can be no doubt that the experiences available and opportunities taken vastly increased over a fifty year period. The paper will consider not only the British situation; references will also be made to similar movements in North America and Australia.

Alan COLLINS | Lancaster University, United Kingdom

Improving memory through natural means: advice on cultivating memory in late nineteenth-century Britain

The idea that memory can be improved is almost as old as the concept of memory itself. Most histories of memory have concentrated on attempts to improve memory through reference to the arts of memory or mnemonics. In this paper, I consider texts on memory improvement from the late nineteenth and early twentieth centuries as examples of texts with a psychological content intended for non-specialist audiences. I highlight how many authors argued that readers should improve their memories by exploiting the natural laws of memory, as revealed by science, rather than resorting to what were portrayed as the artificial techniques of mnemonics. Authors advocating this approach also made repeated appeals to familiar moral imperatives revolving around exercise, training and discipline in ways that brought together natural law and free will. The justifications of their systems accommodated Victorian concerns over determinism, the education of the young, self-improvement, bodily health, and the spread of scientific naturalism. These texts promoted memory as a physical and psychological entity whose management was open to all. Examining them can inform our understanding of emerging notions of psychological expertise, the scope

of the nascent psychological science beyond the academy, and the production of popular knowledge.

T195. Science education

Fri 26 July, 09:00–Sat 27 July, 17:30 • Multiple locations

T195-A. The role of HSTM in teaching to scientists, medics and engineers

Fri 26 July, 09:00–10:30 • Roscoe 1.009

Chair: Charlotte CONNELLY | Science Museum, London, United Kingdom

Andréa VIEIRA | Universidade Federal de Minas Gerais-UFMG, Brazil

Mobilidade Social e Disciplinar e a História da Ciência no Século XX

A cultura da mobilidade varia de acordo com a história, acompanhando o desenvolvimento da sociedade, da política, da economia e se entrelaçando a questões: tecnológicas, científicas, políticas, sociais e antropológicas. A mobilidade, conceito polissêmico, está atualmente inserida no contexto de globalização e remete à ideia de movimento e transposições culturais, provocando transformações na consciência e no imaginário das pessoas, que por sua vez, reflete em suas práticas sociais e no olhar lançado sobre a história e a ciência. Desta perspectiva, pretendo analisar os diálogos da história da ciência, a partir do livro do autor norte americano Thomas S. Kuhn: *The Structure of Scientific Revolutions* (CHICAGO: 1962). Nesta obra, Kuhn reconhece e aponta, dentre outros autores europeus, Alexandre Koyré como o seu principal inspirador, embora Kuhn pertencesse a um contexto histórico sócio-político-cultural distante dos seus interlocutores. De modo semelhante ao modo como vinha sendo desenvolvida a história "tout court" e a história da ciência em parte da Europa, Kuhn naquele momento, também propôs a análise das Sciences hard a partir do diálogo com o campo das ciências humanas e sociais. Percebo que além da interdisciplinaridade e interrelação entre ciência e sociedade, houve ali uma migração intelectual adaptada à cultura e às especificidades do lugar e da época. Proponho com isto, demonstrar as interações e imbricações ocorridas na obra kuhniana, a partir do modelo construtivista europeu de História da Ciência, num cruzamento cultural do pensamento resultado de um processo de transculturação que fez das fronteiras físicas, econômicas e sociais, zonas de contato. Portanto, minha hipótese é que muito antes dos avanços tecnológicos da informação digital ocupar o centro do debate da Globalization of Knowledge, alguns dos efeitos deste processo, como transculturação, apropriação e entrelaçamento do conhecimento já ocorriam na sociedade intelectual, e, principalmente entre historiadores "tout court", filósofos e historiadores da ciência.

Social mobility and disciplinary and the history of science in the twentieth century

The culture of mobility varies according to the history, following the development social, political, economic, scientific, technological, antropológica, weaving them together. Mobility, polysemic concept, is embedded in the context of globalization and refers to the idea of movement and cultural transpositions, causing changes in the consciousness and in people's minds, and this in turn reflect social practices and look about the history and the science. From this perspective, I go analyze the book of American

author Thomas S. Kuhn: *The Structure of Scientific Revolutions* (Chicago: 1962). In this work, Kuhn recognizes and points out, among other European authors, Alexandre Koyré as their main source of inspiration, although Kuhn belonged to a historical context socio-political-cultural distant from his interlocutors. Similarly to how he was being developed, the history "tout court" and the history of science in part of Europe, Kuhn also proposed the analysis of "hard Sciences" from the dialogue with the field of humanities and social sciences. I realize that beyond interdisciplinarity and inter relationship between science and society. There was a migration of culture and intellectual adapted to the specificities of place and time. My proposal is to demonstrate the interactions and imbrications occurred in Kuhnian work, from the European model of Constructivist History of Science, where the cultural crossroads of thought resulted in a process of transculturation, and made of the physical, economic and social, contact zones. So, my hypothesis is that long before the technological advances of digital information occupy the center of the debate on globalization of knowledge, some of the effects of this process, as transculturation and intertwining of knowledge, had occurred in intellectual society, especially among historians "tout court", philosophers and historians of science.

Ketevan KUPATADZE | Ilia State University, Georgia

The history of chemistry in the service of chemistry education

The article presents author's multi-media teaching program on school course chemistry. And the plan of integrated chemical-Historical lesson using mentioned program. In scope of this program is shown the ways to integration chemistry with other subjects, e.g. history and arts. All topics in this digital program have they historical background. For example, if we Consider one example about "Water". What is the water? According to the words of Saint-Exupéry - "The basis of life", which has special chemical activity. From what it contains? From hydrogen and oxygen. Both have wonderful chemical and historical biography. We have spoken about hydrogen and oxygen which are the parts of water. Hydrogen was discovered in 1766 in London by Cavendish. Oxygen was discovered in 1774 by Priestly and Sheele in towns Lids-Upsala. In the block of history the situation in England and Switzerland and the situation in Georgia will be discussed- what was happening in Georgia at that time, which problems (among them-scientific) were to be solved. Is shown animation of historical chemical experiments. After such integrated lessons pupils have looked at mentioned subject differently, they try to find more information and may be, some of them will find in themselves future chemist, or even historian. Their motivation towards chemistry is increased.

Michael GESELOWITZ | IEEE History Center, United States

Using the history of technology to promote an understanding of the impact of engineering solutions among practitioners at the university level

The Accreditation Board for Engineering and Technology (ABET), the primary accreditation organization for post-secondary engineering and technology departments in the United States, requires that all engineering curriculum include courses that teach students about the relationship between engineering practice and society. Internationally, many engineering education accreditation bodies make similar demands. This paper focuses on the U.S. case and explores the current implementations of this requirement. It argues that many engineering schools are having difficulty meeting this requirement in a meaningful way. This paper then argues that history of engineering and technology offers an effective stage on which to illustrate the engineering-society relationships to future practitioners. It then goes on to present the results

of recent efforts to develop history of technology courses for engineering students and to make them available more broadly through on-line education.

Dmitry BALALYKIN | I M Sechenov First Moscow State Medical University, Russia

Teaching the history of medicine as part of a general history of science

Current situation in teaching history of medicine at Russian medical universities is limited by the fact that we are dealing with the first year medical students.

In former times history of medicine was taught to the fourth year medical students. So, we had to exclude from our course a lot of information about clinical medicine – our students just can't understand that. The positive thing is that we changed the focus of our course of history of medicine from medical practice to fundamental science. Now we are trying to teach our students the philosophy and history of science. This is a very radical reform of teaching medical history which contradicts traditional approach.

So, we do it at the I. M. Sechenov First Moscow State Medical University as an experiment. This experience can be recommended to all medical or technical universities when a special historical subject (history of medicine, history of chemistry, history of biology, etc.) is shown as an integral part of general history of science.

First, we suggest unified periodization of history of medicine and general history of science.

Second, we focus students' attention on the First scientific revolution in 17th century as a beginning of the era of science in the modern understanding (principle of general theory, reductionism, experimental method, etc.)

Based on that we produced retrospective analysis of religious and philosophical systems which did or did not contribute to the general epistemological stream.

T195-B. Translating science across borders: the role of textbooks

Sat 27 July, 14:00–15:30 • Roscoe 2.4

Chair: Peter HEERING | University of Flensburg, Germany

Hao CHANG | I-Shou University, Taiwan

Huaxue fenyuan: the beginnings of modern analytic chemistry in China

Huaxue Fenyuan, the earliest book of analytic chemistry translated in China, was first published in 1871. Since that time, many have assumed that the original version for this book was taken from John Eddowes Bowman's *An Introduction to Practical Chemistry, Including Analysis* (Fourth Version) - published in Philadelphia in 1866. However, as our research has discovered, Bowman's Fifth Version had already been published in London as early as 1864.

There are eight volumes in *Huaxue Fenyuan*, including qualitative and quantitative analysis. As an introductory book on analytic chemistry *Huaxue Fenyuan* provides information on a range of rudimentary basics, including such things as conducting analytic experiments, classifying chemical agents in the laboratory, and even how maintain the cleanliness of lab equipment. Moreover, it also encourages the reader to be bold in their attempts at experimentation, providing chapters on how to assemble glass-making equipment, how to maintain the purity of diagnostic agents, and the required agents needed for laboratory experiments. For the Chinese of the time, who were largely ignorant of such chemical experimentation, this book, and the foundational teaching material it contained, no doubt provided them with a most fundamental

and comprehensive survey on the subject analytic chemistry. It was just the beginning.

Seref ETKER | Independent scholar, Turkey

Wahan Effendi (HS Vahanian) and his 1853 Armenian adaptation of Regnault's chemistry primer

Hovhannes Sarkis Vahanian (1832-1891) alias Vahan Efendi (Wahan Effendi), was an

Ottoman Armenian bureaucrat, who was trained as a chemist in France. He served as Deputy Minister of Justice for the greater part of his career, reaching the supreme rank of *Bala* for civil servants. He was also appointed Deputy Minister of Education under 'The chemist' Dervish Mehmed Emin Pasha (1817-1879), and was the director of the Lycée Impérial de Galatasaray for a period. H.S. Vahanian was also a member of the Armenian Educational Council. He edited numerous commentaries on the Ottoman Law of Commerce (in Turkish). Serpouhi Dussap, the renown feminist authoress, was his sister.

Vahanian translated Henri-Victor Regnault's *Premiers éléments de chimie* into Armenian under the title *Isgizpunk Kimiagan Kidutian i beds arhestovarts yev usanoghats* (Principles of Chemistry for artisans and novices) during his education in France. The small volume (12mo, x + 396 p.+ 3 pl.) printed in Istanbul in 1853 is the first book of chemistry in Armenian. Vahan Efendi simplified and abridged Regnault's work to a large extent, leaving out theoretical topics such as the 'théorie atomique'. He preferred the method of writing chemical equations popularised by J.-P.-L. Girarden, when Regnault had already included empirical formulas in his first (1850) edition. Vahanian added various procedures, subjects and notes to his adaptation, which he believed would benefit craftsmen and smiths.

He provided a detailed description for the production of the voltaic pile in the context of galvanoplasty.

Hovhannes Vahanian attempted to create a chemical terminology to meet both the emerging fields of chemistry and to expand the technical vocabulary of Western Armenian, and appended an Armenian-French glossary of chemistry terms to his handbook. Throughout the text Vahan Efendi employed Turkish and Armenian words together for many common objects. *Isgizpunk Kimiagan Kidutian* is the second text of modern chemistry to be published in Turkey, after Dervish Mehmed Emin Pasha's *Usul-i Kimya* (Elements of Chemistry, 1848) in Turkish - another adaptation from contemporary French chemistry books. Dervish Pasha's 'Elements of Chemistry' was intended for use in the military college, while Vahan Efendi's 'Principles of Chemistry' aimed at improving the basic and technical knowledge of apprentices. A primary task for the authors was to devise linguistic patterns for chemical terms coherent with their native languages.

Fuling NIE | Institute for the History of Science and Technology, Inner Mongolia Normal University, China

Science in translation: a comparative study between Chinese and Japanese translation

After the Opium War, a large number of western scientific treatises were translated into Chinese, including William Whewell's *An Elementary Treatise on Mechanics* (1836), John Hersche1's *Outlines of Astronomy* (1851), J. Tyndall's *Sound*(1874) and *Light* (1870)and so on. Most knowledge in these works was introduced in China for the first time, and many physical conceptions were also expressed in Chinese for the first time. Comparing the original texts with translations, this paper will analyse the method and characteristic of physical terms translation. At the same time the situation in Japan and differences between Chinese translation and Japanese translation of physical terms will be discussed.

Ruselle MEADE | University of Manchester, United Kingdom

Charting the development of the technical community in Japan through the re-translations of technical manuals in the Meiji period, 1868-1912

Japan's impressive technological transformation during the Meiji period was initially spurred on by heavy government investment, much of which went into developing technical education. The Kōbu Daigakkō (Imperial College of Engineering), an institution that epitomised the government's approach to technical education, was staffed by highly remunerated foreign teachers who taught in English and prescribed technical manuals in English for their students. However, at the same time a significant number of manuals, many of which were translations, were being published in Japanese for those not catered to by such deliberately foreignised institutions. After 1880 foreign teachers were increasingly replaced by Japanese ones and concomitant with this indigenisation of technical education was a change in the publishing of technical textbooks to respond to the exigencies of a new audience. This resulted in the re-translation of a number of previously translated works. This paper charts the development of the technical community in Japan by comparing translations and re-translations of some of these works, such as W.J.M Gillespie's 'A Manual of Land Surveying' (1873, 1886) and John Rawle's 'Practical Plane Geometry' (1876, 1880). Not only do the re-translations demonstrate a growing self-assurance in the way technical knowledge was communicated, they indicate significant shifts in the profiles of those involved in the production of the book from translators, to publishers, booksellers and readers. The change was not simply one of growing competence; there was a codification of technical communication engendered by the growing authority of local technical institutions and a consolidation of the publishing industry. This study responds to appeals (e.g. Secord 2004) to view the communication of science as an integral part of its formation. Furthermore, it challenges the notion, which has been undergoing re-evaluation for some time, that textbooks are purveyors of staid knowledge, showing them to be sites of considerable creativity where translators demonstrated intellectual dexterity in finding new ways of engaging with the demands of constantly shifting audiences.

T195-C. Science and education

Sat 27 July, 16:00–17:30 • Roscoe 2.4

Chair: William J. ASHWORTH | University of Liverpool, United Kingdom

Victoria BATES | University of Exeter, United Kingdom

Humanising medical knowledge: teaching and testing empathy in Anglo-American medical education since 1945

After the Second World War, medical schools in the United States of America and (later) the United Kingdom developed increasingly interdisciplinary and multidisciplinary curricula. Such shifts were a response to international trends and to the domestic economic/social environment. The changes first took the form of the teaching of philosophy and medical ethics before, from the 1980s in the USA and the 1990s in the UK, medical schools increasingly expanded their curricula by offering optional or integrated 'medical humanities' courses. This proposed paper will examine the integration of philosophy, history and the arts into the medical curricula of many universities and medical schools. It will particularly focus on the aim of new courses in 'medical humanities' and 'medical ethics' to improve empathy and communication skills in medical students. The paper will demonstrate that there was a tension between use of the arts in medical curricula, the objective of creating empathy amongst students and the rise in evidence-based healthcare since 1945. The tension lay in the difficulties of measuring the success of such approaches, which was necessary to ensure the survival of new interdisciplinary and multidisciplinary curricula in the late-twentieth- and early-twenty-first centuries. Such problems resulted in the

development of a number of new strategies for measuring different types of medical 'knowledge' amongst students, including tests for the ethical nature, empathy and humanism of 'tomorrow's doctors'. Overall, the proposed paper addresses the conference theme by demonstrating the impact of new forms of artistic and humanistic 'knowledge' on the transatlantic medical curricula and on modes of assessment.

Brian THOMASSON | University of California, Santa Barbara, United States

Negotiating Darwinism: religious education and evolutionary theories in England's state secondary schools from the 1930s to the 1970s

The historiography on religious reactions to the teaching of evolution has focused almost exclusively on America, but controversy also occurred elsewhere. This paper broadens our perspectives by examining how Religious Education (R.E.) classes in England's state secondary schools negotiated Darwinism from the 1930s to the 1970s. It argues that although English religious educators accepted the general notion of evolution—the common descent of man and all other organisms—they evinced a remarkable reluctance to embrace the Darwinian mechanism of change. Many found the haphazard, trial-and-error method of random variation and natural selection discordant with the benevolent, purposeful God of Christianity. They preferred a teleological theory of evolution—or one directed towards a divinely predetermined goal.

Unlike the U.S., the existence of a state church in England meant that R.E. was a mandated part of public schooling. With both science and religion taught in the same state institution, educators sought a harmonious narrative; yet with Darwinism this often proved elusive. From the 1930s on, each county produced a non-denominational 'Agreed Syllabus' of religious instruction in state schools; such syllabuses commonly addressed science and religion. Yet while they gave lip service to modern evolutionary theory, they often objected to 'chance' explanations, vaguely stressed divine design, and recommended textbooks which opposed evolution by random mutation and natural selection with arguments tantamount to those of modern-day Intelligent Design (such as 'Irreducible Complexity'). Remarkably, Agreed Syllabuses promoted such anti-Darwinian books well into the 1960s, long past the establishment of the neo-Darwinian synthesis of the 1940s. At the same time R.E. organizations presented such teleological theories at student conferences. Not until the 1970s did the R.E. establishment fully accept the neo-Darwinian mechanism, but it now believed the only recourse for a religio-scientific 'harmonization' was a vague approach which compartmentalized science and religion into separate spheres, ignoring the potentially offending philosophical and religious implications of modern evolutionary theory. This paper thus presents a revealing case of how scientific knowledge travels and is reinterpreted across disciplinary boundaries, how ideas considered 'science' and 'pseudoscience' interact in different disciplines, and how science is communicated to the greater public.

Shannon GLEASON | Washington State University, United States

A critical discourse analysis of 'STEM' education in the United States

This paper uses a Foucauldian critical discourse analysis to unpack the new, conglomerate discipline of "STEM", which stands for science, technology, engineering, and math, as a dynamic and productive discursive formation in education that powerfully regulates the kinds of knowledge that are possible and desirable. It then shows how STEM operates as a nationalist discourse that resembles U.S. Cold War-era calls for science education. Further, it shows that STEM is largely a neoliberal project that argues for a global, market-based competitiveness, positioning students as entrepreneurs and marketers of their own employability in heroic service of the nation. The paper draws from three main data sources: the website, publications, and social media presence of the U.S.-based "STEM Education Coalition", a group

of over 500 businesses, professional, and educational organizations; two documents from the U.S. National Governor's Association regarding STEM education agendas; and, finally, documents from the U.S. Congressional Research Service that outline legislative activity and funding for STEM initiatives. Methodologically, it borrows from Allan, Iverson, and Ropers-Huilman (2010), who see policy as a discourse that ought to be contested, disrupted, and illuminated to bring "greater clarity" in understanding policy's "intersections with race, ethnicity, social class, and sexuality" (p. xiv). This paper thus seeks to understand the material, historical, and political meanings of STEM and how the acronym functions as a disciplining discourse.

Li Yingjie | Tsinghua University, China

YANG Jian | Institute of Science, Technology and Society, Tsinghua University, Beijing, China, China

Qu Delin | Tsinghua University, China

The establishment of Chinese graduate education in the 1920s: the Science Institute of Peking University and the Tsinghua Academy of Chinese Learning

At the beginning of the Republic of China, higher education faced two kinds of reformations under the dramatic social changes: one is making itself change from traditional models to modern models; the other is to set up graduate education based on the development of undergraduate education. Through the investigation of the Science Institute in Peking University and Tsinghua Academy of Chinese learning, this paper focuses on the initial creation of university research institutions, scientific research and the institutionalization of graduate education by the ways of analyzing related historical materials and empirical approach. With the development of education, the foundation of graduate education is an important issue faced by every country, such as the establishment of Berlin University in Germany and that of Johns Hopkins University in America. Each country has its own pattern and characteristic, including China. China under the semi-colonial and semi-feudal society needed to learn the existing models of Western countries in order to develop its own. The first physics students, who graduated from Peking University in 1916 demanded the graduate education. A year after Cai Yuanpei became the president of Peking University and established the Science Institute in the University in the same year following the Germany education idea. In 1925, Tsinghua tried to be an independent university from a preparatory school for those students who were sent by the government to study in the United States. Therefore, it decided to found its graduate school called Tsinghua Academy of Chinese Learning, which combined the Chinese traditional academic models with Western university system. Although both Science Institute in Peking University and Tsinghua Academy of Chinese Learning did not last for a long time, they could be taken as an inevitable outcome during the foundation of new institution. Both of them had the critical significance for the further development of graduate schools in China.

T196. Pedagogy and textbooks

Fri 26 July, 14:10–17:40 ▪ Uni Place 4.214

T196-A. Mathematical and technical pedagogy

Fri 26 July, 14:10–15:40 ▪ Uni Place 4.214

Chair: Staffan MUELLER-WILLE | University of Exeter, United Kingdom

Gregg DE YOUNG | The American University in Cairo, Egypt

A medieval Arabic mathematical textbook in rhymed prose

Rhymed prose (*manzūma*) was sometimes used in the medieval Arabic pedagogical context. The rhythmical and rhymed characteristics helped students to memorize more efficiently. The genre was especially popular for introductory treatises which provided the basic foundational knowledge in various fields and which were intended to be memorized by students. Examples of *manzūma* are not unknown in mathematics [G. Shawki, "Manzumāt al-`ilm al-riyādī," *Ḥawliyat Kulliyat al-Insāniyāt wa-l-`Ulūm al-ljtimā`iya*, 7 (1984), 187-235], although they have received relatively little scholarly attention because they rarely contain the innovative mathematics that historians traditionally emphasized. In this paper, I examine, as an example of the genre, a previously unstudied *manzūma* (Tehran, Majlis Shura 5074) based on a specific mathematical treatise – the *Ashkāl al-Ta'sīs*, an introduction to geometry by Shams al-Dīn al-Samarqandī (died 701 A.H. / A.D. 1302). This treatise, one of the most influential geometry textbooks of the medieval period, continued to be copied, studied, and commented upon until the nineteenth century. My paper falls naturally into two parts: (1) an introduction to the genre of rhymed mathematical prose, (2) a comparison of the contents of the *manzūma* with the original mathematical exposition of the *Ashkāl al-Ta'sīs*. Here I assess the effectiveness of rhymed prose for mathematical exposition. What elements of the original treatise had to be sacrificed? Can technical vocabulary be incorporated effectively into rhymed prose? Can diagrams be incorporated effectively into rhymed prose?

Antoni ROCA-ROSELL | Universitat Politècnica de Catalunya - Barcelona Tech, Spain

Technical and scientific collections at the Barcelona School of Industrial Engineering: an approach to engineering education in the nineteenth century

During the XIX century, the collections of models and instruments played a relevant role in engineering education. They made it possible to know and to standardize -according to John V. Pickstone (2000)- the structure and running of machines and installations as a complement to textbooks and atlases.

The Barcelona Higher School of Industrial Engineering was created in 1851 following a decree of the Spanish government establishing a new branch of engineering centred on the industrial world. The scarcity of Spanish industrial development led to the general crisis of the schools system set up in 1851, except for the school at Barcelona which has been running without any interruption since its creation.

In 1851 the School at Barcelona received the collections from the previous centres of technical education existing in the city. In its first "Reglamento" (1852), the collections were already called a "Museum" and were presented as an essential tool for technical education. In the following years, the Museum was enlarged with mineral and industrial products "representing" the wealth of Catalonia and Spain. In 1868, two Museums were formally considered, one including these products and the other including the models and artefacts for demonstration. The School managed to maintain its museums with a relevant function for training until the XX century, when other ways of demonstrative training were introduced.

In this paper, we provide a reconstruction of the history of the collections of the industrial engineering education in Barcelona in the XIX century. We have recently undertaken research work for documenting the history of the school through its archives, and an inventory of the existing collection. Higher Engineering education was based on theoretical lessons, practices in cabinet of models or in industries, on laboratory work, on technical and artistic drawing, and on preparation of projects. In several parts of this scheme, the collection of models, machines, and products provides us with a relevant source for this study.

CHENG Yi-Chin | Department of Mathematics, National Taiwan Normal University, Taiwan

Mathematical narratives of history in popular mathematics books: the case of non-Euclidean geometry

Besides mathematics textbooks, popular mathematics books are another type of media for people to gain mathematical knowledge. In contrast with mathematical textbooks in Taiwan, authors of popular mathematics books can adapt the knowledge of mathematics with more flexibility, including introductions of stories in the history of mathematics. The history of Euclidean and Non-Euclidean Geometries contains some of the most interesting episodes in the history of science, from Euclid's composition of the structure of the Elements around 300BC, to the trials and errors in demonstrating the fifth postulate in the following centuries, and to the eventual birth of the new systems in the 1800s. Because of the importance and theatricality of Non-Euclidean Geometry in the history of the development of mathematical ideas, many authors have delved into this topic. In view of the phenomenon, this paper discusses some of the best-selling popular mathematics publications of different genres, all of which are translated into Chinese, including Leonard Mlodinow's *Euclid's Window: The story of Geometry from Parallel Lines to Hyperspace*, Robert Osserman's *Poetry of The Universe*, Gaurav Suri and Hartosh Singh Bal's *A Certain Ambiguity: A Mathematical Novel*, Okabe Tsuneharu's *Manga Kika Nyuumon*, and Philip Martin's *Einstein and Eddington*. The first two titles are categorized as general popular mathematical books, the third one as a mathematical fiction, the fourth as a mathematical comics and the last as a film. By adopting literary methods, this presentation will explore how the authors narrate the story of non-Euclidean geometry and what messages they want to convey. Their narrative styles and fruitful contents in the history of science and mathematics are the reason why they get wide circularity.

Elmha COELHO MARTINS MOURA | UNESP- Universidade Estadual Paulista de Rio Claro, Brazil

The TWI pedagogy in Brazilian industry in the early years of the 1950s.

As part of doctoral research in the History of Mathematics Education, this text focuses on the implementation of the Training Within Industry (TWI) in Brazilian industry. Known as pedagogy of industrial education, this training method was developed during World War II and it was brought to Brazil by the Brazilian-American Commission of Industrial Education (CBAI) in 1950, with the purpose of forming and perfecting agents and mastery supervisors in the workplace in order to teach properly factory workers. In the method TWI excellence in teaching supervisor or instructor was a decisive factor in the success of training, in case of failure was responsible for the failure in the learning process of their students. Thus, the exercise of knowledge and skills of the supervisor representing the increase in production levels, by generating skilled labor. This method was applied in Brazil in industrial and technical schools, and the various electro-electronic industries, metallurgy, pneumatic, footwear, automotive and other gifts of the main Brazilian states, contributed to the increase in industrial production of the country. The preparation of this paper was based on the analysis of the CBAI Bulletins (1947-1962), produced monthly periodical published by the Commission that their actions developed in Industrial Schools and Technical Schools, and thus spreading the ideology of industrialism in its appearance more naive. The case of TWI shows the presence of a technique rigorously standardized, linked to CBAI operating in industrial education, to the benefit of Brazilian industries.

T196-B. Educational contexts

Fri 26 July, 16:10–17:40 • Uni Place 4.214

Chair: Francis NEARY | University of Cambridge, United Kingdom

Inês GOMES | University of Lisbon, Portugal

100 years of natural history collections in secondary schools in Portugal: the inventories

Teaching objects are material evidence of scientific and pedagogical culture and practices. In Portugal, the role of natural history museums and collections created in secondary schools is still considerably unknown, although their importance is recognized. These collections were broadly used to support teaching in biology, botany or geology, however their constitution and development remains largely unstudied. Today, secondary schools hold important collections, almost intact for decades although inaccessible to researchers and the public at large. This paper presents ongoing research on the natural history collections of Portuguese secondary schools, as far as constitution, organization and use through time are concerned. From 1836, when secondary education was established in Portugal, to 1928, secondary schools apparently had autonomy to purchase materials considered important to fulfill governmental and curricular directives determining their provision with natural history cabinets and botanical gardens. These included a wide variety of objects: naturalized specimens; zoological, anatomical and botanical models; osteological collections; herbaria; geological, mineralogical and fossil collections; crystallographic models and wall charts as well as instruments such as microscopes and projection apparatus. Inventories dating from 1928 from more than 80% of Portuguese secondary schools were analysed with the aim of understanding the economic and material conditions behind constitution and uses of collections, as well as pedagogical tendencies and teaching practices. Results will be presented, including differences and similarities between schools. Moreover, data from inventories were cross-checked with legislation, governmental directives and curricula in order to determine the extent of their actual implementation. The study of these inventories is crucial to understand the role of natural history collections both in the history of education and the history of science, as well as their role today.

Laura KELLY | University College Dublin, Ireland

Medical student societies in late nineteenth- and early twentieth-century Ireland

Writing in his memoirs in 1939, Thomas Garry, an Irish-trained doctor commented: 'The life of a medical student in Dublin in the eighties of the last century was very different from that of to-day. It was more hilarious, probably more picturesque and certainly more squalid' (Garry, 1939) The experiences of medical students, like Garry, have received surprisingly little attention from medical historians. In his important comparative study of medical education in Britain, France, the United States and Germany, Thomas Neville Bonner asserted that 'the lives and experiences of students in general and their impact on medical education have been too little studied'. (Bonner, 1995) Similarly, more recently, Keir Waddington has commented that 'in the historiography of medical education, students are largely absent or silent consumers. (Waddington, 2002). This paper will examine an important aspect of Irish medical student experience: the involvement of students in medical student societies. The first of these societies, the Medico-Chirurgical Society was established at Trinity College Dublin in 1867, with other societies being established at Irish medical schools from the 1870s onwards, such as the Belfast Medical Students Association, the Queen's College Cork Medical Students Association, the Queen's College Galway Medical Society, the 'Bio Soc' of the Royal College of Surgeons and the Irish Medical Students Association, a national body of medical students which was founded in 1944. In common with the medical societies attended by doctors, these student societies held regular meetings where members presented papers on medical and scientific subjects, in addition to discussing concerns relevant to the medical profession. Moreover, these societies had a social function, with committee members responsible for organising student debates, dinners and dances. Drawing on the minute books of these organisations and contemporary student magazines, this paper will investigate the role of these societies in the lives of medical

students at Irish universities in the period. In particular, it will show how these societies not only allowed students the opportunity to further develop their knowledge of medicine and the issues relating to the medical profession but also provided a voice for students, allowing them to air concerns about the quality of teaching they were receiving. Furthermore, these societies, which were regulated to a certain extent by the staff of the medical schools, helped to embody students with a sense of professional unity.

Ana CARDOSO DE MATOS | University of Évora - CIDEHUS, Portugal

From the Instituto Industrial de Lisboa to the Instituto Superior Técnico: places for the teaching of electricity in Portugal

The first degree course in electro technical engineering in Portugal dates back to 1911 when the *Instituto Superior Técnico de Lisboa* was set up by Brito Camacho. However, electricity and its applications were already being taught in a number of teaching establishments including the *Instituto Industrial de Lisboa* formed in 1852. The teaching of electricity at this institution was directly linked to Fonseca Benevides, a physicist who was professor and director at this school. During his travels abroad, Benevides went in search of the latest developments in electrical energy and its applications. His up-to-date scientific knowledge was reflected in the classes he taught at the Industrial School where he organized a modern electricity laboratory in which the first Swan light bulbs in Portugal were used.

When the Industrial Institute was restructured in 1911 to form the Instituto Superior Técnico (IST), Maximiliano Gabriel Apolinário - a Portuguese engineer who graduated from the University of Liège - was responsible for teaching general Electro Technical Engineering, and industrial constructions and installations, while Léon Fech - a Belgian engineer who also graduated from the University of Liège - was put in charge of teaching the Electricity course (General Theory, and applications).

In this paper, we propose an analysis of:

- the evolution of the teaching of electricity from the Industrial Institute to the setting up of the first degree course in electro technical engineering at IST;
- the places in which electricity was taught and how they evolved over the years.

T197. History and historiography of the history of science, technology and medicine

Fri 26 July, 11:00–17:30 ▪ Uni Place 4.206

T197-A. Histories of the history of science, technology and medicine

Fri 26 July, 11:00–12:30 ▪ Uni Place 4.206

Chair: R Angus BUCHANAN | University of Bath, United Kingdom

Liviu-Alexandru SOFONEA | Transilvania University of Brasov, Romania

Elena HELEREA | Transilvania University of Brasov, Romania

On the history of ICOHTEC: the contribution of some Romanian institutions and devoted persons

in the historical period named the 'Cold War', and after, in the 'transition period'

In the World War Two and also (*a fortiori*, specifically) after this dramatical "marker of history" – in the post-world war period, marked by the "cold war" (1945-1956 – 1989/2990) the creation, dissemination, deployments of knowledge and the useful /practice/ in the world, and *a fortiori* in societies in transition of East Europe were extremely complexes (separate, *in interaction*; in space, in time, et al.).

In this long, non-linear period it was conceived by eminent persons (clever, humanist, visionary; influence-al) the trans-national & trans-ideological institution ICOHTEH. From the very beginning, Romania /RSR/ was directly, specifically involved. Many contacts were made with USA, Soviet Union, UK, West Germany, France, Spain, et al., persons, institutions; the presidency of this new, modern, glorious *Institutio* was exerted long time by a Romanian prominent scientist-engineer and academician; the participation of Romanian researchers to the scientific meetings were numerous and relevant.

After the end of the cold war the Romanian participation to ICOHTEC was not at all decreased; the program of the Romanian Section for the near future is now achieved: it is promising.

In this complex *elaboratum* are presented relevant aspects of: historical evolution, learning, museology, pedagogy, connections; also, some views about the future.

Patrick PETITJEAN | Université Paris Diderot, France

L'académie internationale d'histoire des sciences des années 1930-1950: une impossible tour d'ivoire

Dès sa naissance, l'Académie internationale d'Histoire des Sciences est confrontée à la politique : exil d'Aldo Mieli à Paris, et présence d'une délégation soviétique au 2e congrès (Londres, 1931). Dans la décennie suivante, elle fait face au fascisme et au nazisme : annulation, après d'âpres débats, du congrès de Berlin en 1934, remplacé par un congrès dans le Portugal de Salazar; projet d'un congrès au Brésil de Vargas; élection d'un président soutenant Mussolini en 1937.

Au sortir de la guerre, l'Académie, à reconstruire après avoir cessé d'exister pendant la guerre, est confrontée à un double défi : la pression pour partenariat étroit avec l'UNESCO de Joseph Needham, avec une adhésion l'ICSU impliquant la transformation de son fonctionnement, et la reconnaissance de l'histoire sociale des sciences, avec une commission "histoire des relations sociales de la science" (Léon Rosenfeld, Samuel Lilley).

Sous l'impulsion de George Sarton, un compromis est trouvé avec l'UNESCO pour sauvegarder le caractère « élitiste » de l'Académie (auto cooptation des membres), avec la création en 1947 d'une structure tampon, l'Union internationale d'Histoire des Sciences, adhérente de l'ICSU, mais contrôlée par l'Académie et dont l'existence restera plutôt formelle les premières années. La commission « Rosenfeld-Lilley » ne survivra pas pour cause de guerre froide.

George Sarton a été la figure centrale de l'Académie dans sa confrontation aux enjeux politiques durant ces années. Héraut de la « neutralité » de l'Académie, Sarton justifie une conception élitiste de l'Académie par le caractère « individuel » du travail scientifique. Mais ses conceptions de « l'humanisme scientifique » n'en comportent pas moins une dimension implicitement politique, affirmée notamment dans sa conférence lors du congrès au Portugal en 1934, bien que distante de toute prise de position explicite. Cette attitude n'allait pas sans provoquer des heurts réguliers avec Charles Singer.

L'implication de George Sarton dans la vie publique, en Belgique puis aux Etats-Unis, révèle cependant une personnalité plus complexe que son image au sein de l'Académie.

Koji KANAYAMA | Tokyo Institute of Technology, Japan

Japanese social constructivism of technology in the 1940s: Sakaji Yamada and Haruki Aikawa

In this paper, we shed light on the intellectual roots of Japanese philosophers' concepts of technology in the 1940s. We point out that Marxist philosopher Sakaji Yamada's view in 1946 may be regarded as a branch of social constructivism of technology and that Yamada followed Haruki Aikawa's view of the wartime.

Japanese debate on the nature of technology had begun in the 1930s. We can name many left-minded persons who actively worked in this field, but the most brilliant among them has been Aikawa, who was a Marxist in his young age but then cooperated with the Japanese militarist government during wartime. Before him, the most accepted definition of technology was that technology is the system of instruments of labor. Aikawa, succeeding in the development of this concept, formed his original view around 1940, which was based on the relationship between labor and technology.

After the end of the war, the first debate on the nature of technology in occupied Japan occurred between Yamada and Mitsuo Taketani, a well-known physicist, in 1946. This debate occurred in the absence of Aikawa because he surrendered to the Soviet army in August 1945 and was kept in Siberia at that time. Taketani, denying the previous (including Aikawa's) concepts of technology, argued that the nature of technology lies in the conscious application of the objective natural law. Yamada, opposing to this view, stated that Taketani oversaw the dialectical relationship between nature and human labor. According to Yamada, technological foundation of a society does not have its roots on nature that exists as an isolated system from human labor, namely technology is a sociological phenomenon, not the simple application of the natural law.

Taketani responded to Yamada indirectly, but because of the former's arrogance and offensiveness, sadly, disputes between them did not lead to fruitful results. Vulgarness of this battle between Taketani and Yamada may have let historians not to consider it seriously. However, if we regard writings of Yamada concretely, it appears that his standpoints have much in common with those of social constructivism of technology. His view presents a striking contrast with those of Taketani, which were similar to technological determinism or technological utopianism. By examining books and pamphlets of the wartime period in Japan, we also point out that Yamada's concept was not original, but writings of Aikawa may have matured Yamada's dialectical view.

T197-B. Nineteenth- and twentieth-century humanities and social sciences

Fri 26 July, 14:00–15:30 • Uni Place 4.206

Chair: John PICKSTONE | University of Manchester, United Kingdom

Chris MANIAS | University of Manchester, United Kingdom

Constructing the world of the cave artist, 1870-1930

The discovery of palaeolithic art in western and central Europe in the late-nineteenth and early-twentieth centuries was one of the most striking developments within the new and publicly prominent scholarly field of human prehistory, with implications which cut across the cultural, "deep time" and evolutionary sciences. At La Madeleine, Les Eyzies, Altamira, Dolní Věstonice, and a host of other sites, carved bones, wall-paintings and statuettes were discovered depicting long-extinct animals, abstract designs and a few rare human figures. These mysterious productions needed to be worked into existing frames of knowledge. Yet how this was to be done split scientific and scholarly communities. Debates over authenticity - either of the field as a whole, or of individual pieces - were frequently expressed. Meanwhile, the representative nature of much of the material gave many the idea that prehistoric artists

were crude copyists, lacking abstract thought and at a low and undeveloped mental level. However, the apparent ceremonial nature of many of the productions and their complexity and technical skill moved other interpretations beyond this, perhaps showing that human drives towards creativity were built in at an ancient period. Moreover, a continual comparison of prehistoric art with the art of "primitive" societies and children, and the increased regard for palaeolithic archaeology as a documenter of human social, cultural, mental and "racial" evolution, ensured that these finds were given a wide relevance.

This paper will look upon how these discoveries worked across numerous disciplinary boundaries - including psychology, palaeontology, art-theory, archaeology, neurology and physical anthropology - and also national ones, as finds and sites in western and central Europe were compared with artistic productions of a range of peoples within the international fields of prehistoric archaeology and human evolutionary studies. In this process, notions of race, aesthetics, mental evolution, gender, and humanity's relationship to the natural world intermixed. Examining the theories and observations of Gabriel de Mortillet, Edouard Piette, Henry Fairfield Osborn, Henri Breuil, and Moritz Hoernes, this paper will consider the interplay between these areas, as working knowledge of the art of the Palaeolithic into a comprehensible framework became a means of engaging with the mind of primitive man, and clarifying human capacities for knowledge and creativity.

Bart KARSTENS | Philosophy, Leiden University, Netherlands

Patterns and principles in nineteenth-century comparative philology

Under the aegis of Franz Bopp (1791-1867) a new study of language was shaped in the 19th century namely historical and comparative linguistics. The new way of approaching language was decidedly more in spirit with approaches known in the natural sciences. It is fair to say that this way of language study was the forerunner of what we now know as general linguistics. At least Bopp was the first person to occupy a chair in 'Allgemeine Sprachkunde' as early as 1821. In my talk I will trace direct influences of the natural sciences on comparative philology and vice versa. These were visible both in methodological principles as in explanatory patterns. I will show what these patterns and principles were by looking at the contributions of both Bopp and Grimm, the main actors of the 1st generation of comparative linguists. Among the 2nd generation considerable difference of opinion came about whether linguistics should be (or become) a natural science or remain strong ties to the more culturally oriented philology and thus remain part of the humanities. This tension was already present in the work of Bopp itself but rose to the surface only in debates between prominent members of the second generation with Schleicher and Müller on the one side and Curtius and Whitney on the other side. I will consider what the alignment to either the natural sciences or to the humanities meant for the comparative study of language and how this choice shaped the further development of the principles and patterns the 1st generation had begun to create. The study of this episode is interesting for at least two reasons. First it serves the broader theme of the humanities as knowledge making disciplines. Second it provides insight in interdisciplinary relations across the natural sciences as well as the humanities in the 19th century. This is an understudied area of research and including the humanities in it provides a useful check on the natural science dominated historiography of the period.

Marcia ROSETTO | University of São Paulo, Brazil

The history of science and information science: dialogues between George Sarton and Paul Otlet

By the end of the 19th Century and beginning of the 20th Century, international studies and events grow intensely as spaces for the reflection and definition of proposals about the ways of implementing bibliographic controls of the large documental volume worldwide, aiming at retrieving and accessing scientific publications' repertoires. According to W. B. Rayward, historiographical studies on "document and

information” refer to the development of treatment and dissemination methodologies promoted by Paul Otlet. During the same period bibliographies in the field of the History of Science were also conceived and organized by George Sarton. Considered one of the main articulators for the institutionalization of the History of Science, in 1913 he publishes the *Bibliographie Analytique des Publications Relatives à l'Histoire de la Science* and in this same year begins an important information and documental exchange with the *Répertoire Bibliographique Universel* (RBU) created by Otlet, with the purpose of introducing the History of Science among its themes. Letters exchanged between Sarton and Otlet can be found at the *Mundaneum – Centre D'archives de la Communauté française* and in the *Widener Library at Harvard University* during studies and research in the Post-Graduate Program at the Simão Mathias History of Science Studies Center (São Paulo, Brazil), we were able to perceive that Sarton took part in the 1913 *Conférence Bibliographique Internationale*. This participation is due to the fact that Otlet considered History of Science a fundamental element of interaction with the other sciences. As from this moment a continuous exchange starts between the institutions. It is believed that the result of the research identified the proximity between History of Science and Information Science, evidenced by the analysis of documents located and obtained from Sarton and Otlet, and supplemented by information sources that have led to inferences showing that the two areas have interaction links in different dimensions. Such initial results should be considered a necessary tool for the performed systematization, leading to the configuration on the characteristics of the universe of studies and research in the History of Science, and it can be said that it will be able to contribute to and provide subsidies for a continuation in this direction.

Rens Bod | University of Amsterdam, Netherlands

The humanities as knowledge-making disciplines: the search for patterns and principles

The humanities have been viewed as a separate class of disciplines ever since Wilhelm Dilthey introduced his influential distinction between *Geisteswissenschaft* and *Naturwissenschaft*. Yet a comparative historical investigation of the humanistic disciplines shows a strikingly different picture: humanistic practice is characterized by an unbroken tradition of a search for patterns and principles in texts, art, languages, music, literature and theatre. This search is found in all periods and regions, and although it was dismissed by Dilthey and others, it continues to be part and parcel of humanistic practice. For example, in art history we find stylistic and iconological analyses carried out by a principle-based approach (initiated by Wölfflin, Panofsky and developed by others). The narratological, rule-based analysis of literature was initiated by Propp and Todorov. And principles and rules are also found in linguistic analysis (Chomsky, Joshi and others), musicological analysis (Schenker, Lerdaahl) and theatre analysis (e.g. universal acting rules by Barba). This paper investigates the nature of the knowledge produced in the humanities, in particular with respect to the notions of patterns and systems of rules. Some rule systems aim at defining a consistent and procedural set of rules, which occurs, for example, in linguistic and musical grammars. We will refer to these systems as procedural rule systems. More often, however, the rules do not constitute a formalized set but 'declare' what might be called restrictions for certain literary and artistic genres. They are similar to what in the information sciences is sometimes referred to as a declarative rule system. Thirdly, there are also rule systems that only give tentative, heuristic rules and to which we will refer as a heuristic rule system. In our comparison of rule systems, we find that there is no radical distinction between the humanities, social sciences and natural sciences. Instead there is gradual course between the most 'informal' humanistic disciplines such as poetics, to the most formal natural sciences such as physics, where some (sub)disciplines, such as theoretical linguistics, lie closer to physics than does a biological discipline like ethology. Philosophers of the humanities were wrong in believing that there is a constitutive distinction between *Geisteswissenschaft* and *Naturwissenschaft*. The study of actual humanistic practice shows otherwise.

T197-C. Professional issues in HSTM

Fri 26 July, 16:00–17:30 • Uni Place 4.206

Chair: Anne BARRETT | Imperial College London, United Kingdom

Simon WERRETT | University College London, United Kingdom

Making science sustainable: lessons from the history of science

Currently many scientists are seeking ways to turn energy-hungry scientific research into a more sustainable practice. This paper uses examples from the history of science to explore potential avenues for making science sustainable. Prior to the twentieth century and 'Big Science', natural philosophers employed material culture in experimental settings with a care and thrift that has little considered by historians of science. In fact, the 'new science' of the seventeenth and eighteenth centuries featured a variety of techniques and approaches to knowledge-making that might be considered 'sustainable' today, and this paper will examine some of them. Drawing on the world of artisanal work and domestic labour, they included the adaptation of existing space to scientific research; the use and adaptation of locally-available material resources for experimental investigations; activities of maintenance and repair; and a widespread culture of second-hand exchange and material bricolage. The focus of this paper will be a series of exchanges between the electrician Tiberius Cavallo and the physician James Lind between 1782 and 1809 that illustrate many of these practices and show their import for the making of enlightened scientific knowledge.

Milada SEKYRKOVÁ | Institute of the History of Charles University and Archive of Charles University in Prague, Czech Republic

'Drop me a line', or, the twilight of scientific correspondence?

What does electronic environment mean for scientists researching the history of science and technology? What sources can one use at present and what sources will be available in the future?

The Central European environment is still looking for a solution to this pressing problem. Against the background of correspondence of three outstanding Bohemian scientists of the last 150 years, this contribution offers some thoughts regarding changes in the way scientific correspondence is carried out and subsequently also in the ways it can be used in historical research.

As examples, this article uses Jan Evangelista Purkyně (1787–1869), professor of physiology in Wrocław and Prague and one of the first advocates of Darwin's theory in the Bohemian lands, Otto Wichterle (1913–1998), professor of technology of plastic materials at the Czech Technical University in Prague and inventor of contact lenses, and Antonín Holý (1936–2012), professor and discoverer of a number of antiviral drugs used in the treatment of HIV/AIDS, hepatitis B, and herpes.

Based on their extant correspondence, that is, based mainly on a pictorial presentation, this contribution reflects on the changes that occurred between the nineteenth century and the present and on their impact on the creation of sources that can be used in researching the history of science.

Jenny SHAW | Wellcome Trust, United Kingdom

Documenting science: applying archival theory to the Human Genome Project

Collecting the records of modern science poses many challenges for archivists and it has become increasingly clear that the traditional approach for scientific archives is no longer suitable. In the UK, the approach for preserving scientific archives has been heavily influenced

by that adopted by the Royal Society and the Royal Commission on Historical Manuscripts in 1967. Their pilot project successfully preserved the papers of three distinguished and recently deceased scientists and has been used as the model ever since with its influence still shaping activity today. While this approach has undoubtedly ensured that many scientific collections have been preserved, its focus retrospectively on the "great men" is increasingly disconnected both from modern science and archival theory.

Modern science is inherently collaborative, frequently bringing together researchers from across a multitude of disciplines and continents. It is highly questionable whether preserving the archives of a single outstanding individual will ensure that the results of the collaboration are effectively captured. Additionally, it is important to recognise that science is not done in a vacuum and that interaction with politics, the media and broader society also need to be captured alongside the scientific record.

The growth in the use of computers in science, as in all areas of life, presents a challenge to retrospective collecting as much of the material needing to be preserved will have been born-digital. All of the advice surrounding the preservation of digital material urges action as early as possible to address its increased vulnerability. Clearly waiting until the death of a scientist before starting to preserve their digital material is no longer viable.

The Human Genome Archive Project (HGAP) aims to preserve the archival legacy of one of the most important scientific achievements of the twentieth century. In the UK, a survey of material created between 1977 and 2004 relating to the sequencing of the human genome is currently underway. To deal with collaborative science and a large proportion of digital material, this survey is challenging the traditional approach to scientific archives by drawing on archival theory and examples of its practical application. This paper will use the experience of the HGAP to illustrate how archival theory can be applied to document modern science.

Margaret ROSSITER | Cornell University, United States

The Rockefeller Foundation and the history of science

Between 1930 and 1970 the Rockefeller Foundation made several grants to historians of science (broadly interpreted) who eventually ended up in the United States. Among these were Otto Neugebauer, the Austrian historian of ancient mathematics, who eventually found an academic home at Brown University, George Sarton, a Belgian-American historian of science but only after he retired from the staff of the Carnegie Institution of Washington, Henry Guerlac of Cornell University, and political scientist Don K. Price of Harvard University. In his long career at the Rockefeller Foundation Warren Weaver, originally a mathematician, was involved in each of these award decisions. As correspondence at the Rockefeller Foundation Archives in Tarrytown, NY, USA, shows, two of the four were made reluctantly but turned out to be quite successful. The other two were almost routine and had more mundane even modest outcomes. From this one might conclude that challenging program officers to stretch their preconceptions and go beyond their comfort levels can have strongly particularly positive results.

S199. Science, technology and medicine in the Ottoman Empire

Tue 23 July, 09:10–12:40 • Roscoe 1.010

Symposium organisers:

Tuncay ZORLU | Istanbul Technical University, Turkey

Eftymios NICOLAIDIS | National Hellenic Research Foundation, Greece

Symposium abstract

No abstract received.

S199-A

Tue 23 July, 09:10–10:40 • Roscoe 1.010

Chair: Tuncay ZORLU | Istanbul Technical University, Turkey

Hasan UMUT | McGill University, Canada

The Ottoman encounter with European science: the case of logarithms

Many studies in the history of science literature have evaluated the introduction of new science into non-European societies within a limited perspective. This process has been generally called as "transfer" or "reception" which mainly implies that non-European societies were passive and that their only function was to transfer new knowledge with no regard to their local contexts. Studies that have been made so far tend to disregard the multi-directional and complex patterns of this process and ignore the historical, political and social backgrounds and implications of it. In this talk, I will focus on the introduction of logarithms invented in Europe in the seventeenth century, into the Ottoman Empire as an example. Based on an analysis of the Sharhu Cadavil-i Al- Ansab (Explanations of the Tables of Logarithms), by Ismail Gelenbevi, one of the leading mathematicians in the Ottoman Naval Engineering School in the eighteenth century, on logarithms, I will argue that Ottoman encounter with new science in general and logarithms in particular was an active process which affected and was affected by the contemporary Ottoman scientific and social discourses. In this respect, I will discuss the political, social and intellectual implications of the appropriation of logarithms by Ottoman scientists and thereby show how investigating the transfer of certain mathematical concepts can reveal the dynamics of the process of transfer from Europe to non-European societies itself and thereby prove an important tool for historiography in general.

Atila BİR | Istanbul Technical University, Turkey

Mustafa KAÇAR | Istanbul University, Turkey

The theory and practice of Ottoman sundials

Theory and Practice of Ottoman Sundials

The sundials are composed of a stick giving a shadow perpendicular to a table or wall plane. On a sunny day the shadow of the stick-end on a plane follow a hyperbolic curve. The sundials are generally classified as being spherical, horizontal or vertical. Most of the Greek and Roman sundials are spherical and few of them cylindrical or conical. The most of the sundials were also in use in early Islamic time. But, in contrast the sundials construct in Islamic period are generally horizontal or vertical dials.

On Islamic horizontal sundials other than the gnomon perpendicularly placed to the horizon, they are generally a second stick or stretched wire (*polos*) oriented parallel to the earth axis and making an angle of which is equal to the latitude j of the lieu. Since during one day the sun makes a tour around the earth axis it also makes a tour around the *polos* sweeping each hour an angle of $360^\circ/24 = 15^\circ$ and each degree correspond to 4 minutes. On a plane perpendicular to the earth axis the shadow of the *polos* give the hour angles directly. But since on horizontal sundials the dial is not perpendicular on the earth axis the hour angles have to be projected to the dial plane making an angle of j latitude degrees with the earth axis.

In this paper, the time concept used by the Ottomans is briefly summarised. Secondly the theory based on this time concept applied to the Ottoman gnomonic. And at the end some horizontal and vertical

Ottoman sundials are investigated in detail. The use of this dials on day life *praying* and legal (*Sheri*) time of Ottomans sundials are discussed.

This presentation is based on work co-authored by Burak Barutçu.

Tarik Tuna GÖZÜTOK | Ankara University, Turkey

İbrahim Müteferrika and the modernization of Turkey

İbrahim Müteferrika, was perhaps, the first of a series of Europeans who were destined to play role in the history of Westernization of Turkey as carriers of new ideas and intermediaries between cultures. Müteferrika was the to introduce the of change and progress and modern scientific thinking into Turkey. In 1729, he established the first printing press facilities in the Islamic world in İstanbul. Initially, he published books on non-religious subjects, including politics, military strategy, magnetism, geography and astronomy. Müteferrika was not only a printer, he was also an editor and writer of books on scientific subjects. His favourite subjects were geography, physics and military tactics. He used to call himself a geographer. In 1732 he printed Katip Çelebi's famous book of geography called *Cihannümâ*, to which he added maps and figures, and an introductory these ideas were not yet accepted by the Muslim scholars. Müteferrika, also discussed, for the first time in Ottoman Empire (now Turkey), Descartes' theory of vortices, Galileo's rejection of Aristotelian physics, and magnetism and the compass. In short, he became one of the early transmitters to Turkey of the new ideas produced by modern European science.

Ioanna G. STAVROU | Department of Chemistry, University of Ioannina, Greece

From the tradition of 'giatrosophia' to Brugnatelli's pharmacopoeia in the Greek-speaking regions of the Ottoman Empire in the beginning of the nineteenth century

authors:Ioanna G.Stavrou,Efthymios P.Bokaris In the greek-speaking regions of the Ottoman Empire until the end of the 18th century, pharmacopoeia was practiced empirically such as medicine. Several categories of empirical doctors existed like the ones named "vikogiatroi" in Epirus and were similar to the "drugjists" in Europe. They prepared their medicines using the instructions of medical wisdom manuscripts ("giatrosophia" in Greek) which they included plenty of recipes in which the ancient medical tradition coming from *materia medica* of Dioscourides, Plinius, etc. is usually mixed with charlatanism and magic of all kinds. In February 1818 the work of "philosopher, teacher and doctor" Dionyssios Pyrrhos was published with the title "New Pharmacopoeia". The aim as explained in the book was to "be beneficial and necessary not only to Doctors and Pharmacists but also to each cognitive man, because with this everyone can prepare almost all medicines, know their power and action along with the way of use, the dosage and their adjustment to man's passions". The book was printed in 2000 copies and has been recognized as a best-seller of that era. Despite the empiric character of the author's knowledge it is with this work that the first scientific approach of the art of the preparations of medicines is introduced in the greek -speaking regions, since it is based on the translation of the Italian Luigi Valentino Brugnatelli's *Pharmacopoea Generale* (1814). Brugnatelli was the professor of General Chemistry in Pavia University and had adopted a naturalistic approach of Lavoisier's Chemistry with which his pharmacopoeia is introduced. In depth research of this transition -from "giatrosophia" to Pyrrhos's *Pharmacopoeia*- demonstrates the conservation of the tradition of *materia medica* under the view, however, of the "new chemistry" which constitutes the basis of the academic establishment of pharmacopoeia in Greece after it was deliberated from the Ottomans.

This presentation is based on work co-authored by Efthymios P. Bokaris.

Ekmeleddin İHSANOĞLU | Turkish Society for the History of Science, Turkey

The house of sciences: how to establish a modern university in Islamic cultural context

This paper examines the process of founding a western institution, namely a university, in an environment belonging to a different type of civilization. The host of this western institution of learning belonged to another civilization; actually, this civilization possessed deeply entrenched academic traditions and institutions of its own that made the transfer process much more than a simple process of appropriation. This was an Islamic civilization and the initiators of this modern institution of learning were the Ottoman administrators and intellectuals; a fact that left its mark as the distinctive features of this process.

The Ottoman administrators and intellectuals who formed the leadership of the Islamic world also aimed at the formation of a modern Ottoman culture built on a harmonious synthesis between the Islamic and Western cultures. Their keenness to create their own version of modernization was very clear from the beginning where they coined a new word for the institution they were about to establish. For the modern institution of higher education known in the West as a university, they coined the term *darülfünun*, i.e. 'house of sciences'. As, from the very beginning, they had set about founding this new institution on their own resources, it was never a simple or straightforward process.

The reform measures the Ottoman intellectuals and administrators decided to adopt in the attempt to bridge the gap with Europe resulting from the industrial revolution included the foundation of a modern university as a completely new institution rather than the simple transformation of the existing pre-modern educational institutions. At the same time, this new project formed part of the French educational system that the Ottoman administrators had adopted as their model. Public educational policy ensured that public education should be divided into primary, secondary and higher education and that it should be state funded. This became possible only with the centralisation of the state administration.

Besides examining the various aspects of the foundation of a *darülfünun* within the general context of Ottoman modernisation, this paper will also aim at throwing some light on an important and pioneering experiment involving both the Islamic world and Western culture. This study challenges the conventional opinion, which maintains that the longtime elapsed –almost half a century- to establish the full-fledged Ottoman university was due to the opposition of those who were against reform policies and did not welcome the modernization of centuries old Ottoman educational system.

S199-B

Tue 23 July, 11:10–12:40 ▪ Roscoe 1.010

Chair: Mustafa KAÇAR | Istanbul University , Turkey

Ferhat OZCEP | Istanbul University, Turkey

The historical development of ideas and scientific institutions about geophysics in the Ottoman Empire

In Anatolia, the history of geophysical sciences may go back to Antiquity namely the period that lived Thales in Magnesia. In modern sense, geophysics was started with the geomagnetic works in 1600's. The period among 1600 and 1800 years includes the magnetic declination, inclination and strength measurements. Before these years, there is a little information, how is used a compass, in the "*Kitab-i Bahriye*" (the Book of Navigation) of Piri Reis who is one of the most important mariner of the Ottoman Empire. Although this may not understand that magnetic declination angel knows in generally. The first scientific book related the geophysics is the book of "Fuyuzat-i Miknatissiyeh" that was translated by İbrahim Müteferrika and that was printed in 1731. The subject of this book is the earth's magnetism. There is information concerning with the geophysics in the book of "*Cihannuma*" that was written by Katip (Celebi) and in the book of "*Marifetname*" that written by İbrahim Hakki Erzurumlu

but these books are partly geophysical books. In Istanbul, the year of 1868 is one of the most important year for geophysical sciences. Because an observatory called "Rasathane-i Amire" was installed around Pera region in this city. In this Observatory, the first systematic geophysical observations such as meteorological, seismological and even gravimetric was made. There have been the meteorological records in Anatolia since 1839. These records are concerning with temperature, pressure and humidity of the weather. In the Ottoman Empire, the science of geophysics is one of the natural sciences such as astronomy, mineralogy, geology and etc., and these sciences were agreed as a part of physics and chemistry.

Tuncay ZORLU | Istanbul Technical University, Turkey

Engineering and humour in the late Ottoman Empire: the journal *Shaqa*

Engineering and Humour in the Late Ottoman Empire: The Journal 'Shaqa'

This paper focuses on a humour journal 'Shaqa' which was issued by the students of the Mühendis Mektebi (Engineering School) that offered training between the years 1908-1928 during the late Ottoman and early Republican periods and turned out to be today's Istanbul Technical University. This journal includes not only technical information about the engineering education of the time but it also covers some drawings and cartoons related to the instruments used by the engineering education.

Reader can also taste a kind of the social history of engineering through various articles and poems written by engineering students.

Conceptualisation of engineering, extents of tolerance, perception of women, changing moods and psychology of the students, famous teachers, comparison with other schools, tuberculosis as a deadly disease, problems of the students, difficulties of education in the time of national struggle during the WWI are among many topics included in the journal.

Cemil Ozan CEYHAN | Istanbul Technical University, Turkey

Robert College Engineering School

Engineering education has always been the driving force of modernisation in all countries as it is in Turkey. Robert College Engineering School was one of these important places where students were graduated not only as an engineer but also as an intellectual. It is founded in 1912 and served until it is transformed into Bogazici University in 1971. This study focuses on the history of Robert College Engineering School, its place in engineering education in Turkey and relations with the mainstream engineering education which has roots in military engineering education.

Efthymios NICOLAIDIS | National Hellenic Research Foundation, Greece

Scientific policies in nineteenth-century southeastern Europe: the Ottoman Empire and the new national states

During the 19th century, the Ottoman Empire tries to redefine its attitude towards science. This attitude goes from the suspicion, at beginning of the century, towards new knowledge coming from Europe, to the appropriation of European science taught in the newly founded Istanbul University at the end of the century. This appropriation didn't come without hard debates, mainly between the traditional ottoman milieu and a new generation belonging to the upper class who has studied in European Universities and Schools of Engineering. This change of mentalities, followed by the willing of the Ottoman State to modernize its structures and plan a scientific policy was a long process, concluded by the new Turk state after the Kemalist revolution.

On another hand, the National Revolutions of the 19th century which were at the base of the creation of the new national States of Greece, Serbia and Bulgaria, had at their basis the idea of scientific modernization. Science education was considered as a means of national emancipation. The European countries educational models

were the ideal of the new establishment of these States, which at their foundation defined an educational policy on science following French, English or Austrian model,

In our paper we will try a comparative study between science policies in the Ottoman State and the new national states of the Balkans during the 19th century.

T201. History of technology

Wed 24 July, 09:10–15:40 ▪ Uni Place 4.214

T201-A. Ships

Wed 24 July, 09:10–10:40 ▪ Uni Place 4.214

Chair: Neil BROWN | Independent scholar, United Kingdom

Paloma DE LA VALLÉE POUSSIN | Université Catholique de Louvain, Belgium

Scientia navalis – Modern mechanics applied to ships

Scientia navalis: la mécanique moderne appliquée au navire

La scientia Navalis d'Euler paraît en 1749. Ce traité imposant a pour sujet la Science Navale, ou encore la mécanique appliquée au navire. Le premier tome se concentre sur la mécanique appliquée à l'équilibre et au mouvement d'un corps flottant quelconque, alors que le second tome applique les résultats obtenus spécifiquement au navire.

La scientia Navalis s'intègre dans un ensemble de travaux contemporains, qui témoigne de l'introduction de la mécanique dans la construction navale. Cette introduction des sciences commença par les travaux entre autres de Stevin, Hoste, et de La Croix, sur la stabilité et les mouvements du navire. Plus tard, les recherches sur la mécanique du navire furent soutenues par le Prix Rouillé de Meslay de l'Académie des Sciences de Paris, qui traitait d'un sujet naval un an sur deux. Ce prix stimula de grands mathématiciens, tels Euler, à se pencher sur des questions navales.

La Scientia Navalis se distingue par la modernité des outils mécaniques et mathématiques utilisés, ainsi que par sa rigueur. En particulier dans le premier tome, le principe d'Archimède est démontré, le moment d'inertie est nommé, les mouvements et les forces sont décomposés selon des axes perpendiculaires, etc. Il se dégage du texte une impression de parfaite clarté, mais aussi, il apparaît qu'Euler saisit l'opportunité de la recherche sur le mouvement du corps flottant pour résoudre des problèmes mécaniques qui lui sont propres. Par exemple, dans ce cadre particulier se pose la question de l'axe de rotation du corps en mouvement oscillatoire que décrit le navire dans le roulis. D'autre part, l'interaction entre le solide et le fluide, provoquant la flottaison, mais aussi l'impulsion du vent dans les voiles, et la résistance de l'eau, est étudiée de près avec la mécanique de pointe de l'époque.

Ce travail se propose de mettre en évidence la modernité de la mécanique qu'Euler utilise au service de la recherche fondamentale sur le mouvement du corps flottant, mais aussi dans son application au problème pratique et concret qu'est la construction du navire.

Weiqliang ZHOU | National Palace Museum, Taiwan

同安船與清代中期的海防

同安船為清中葉興起的新型海船，不但廣為民間使用，也被海盜利用，最後並成為清帝國外海水師的主力，其布防遍及渤海到臺灣，是輪船出現前，最具代表性的中國古帆船之一。院藏〈集字號大同安梭船圖〉和〈一號同安梭船圖〉是同安船的重要圖像史料，帆船之型制與彩繪細緻，且有其它奏摺史料配合說明，不僅是本院極為特殊的海洋史藏品，也是海洋史尚未深耕的課題。國立故宮博物院以院藏〈集字號同安梭船圖〉和相關清代檔案為核心，配合相關歷史文獻，以第一手的研究為基礎，運用打造模型船、拍攝紀錄片，製作3D模型和製作展覽等方式，重建同安船與19世紀東亞海洋文明的繁盛樣貌。透過同安船的風華再現，我們可以從政治史、軍事史、經濟史、社會史科學史和海洋史等等不同角度，重新審視18世紀以來臺灣和東亞息息相關的發展脈絡。

The Tongan-style warship and coastal defense before the Opium War

Tongan-style Warships, a new type of ship built in Fujian area in the mid-Qing Dynasty, not only widely use in civil and pirates, but also service in the Qing Imperial Navy's before the Opium War. They are the last Chinese sails before steamboat appears. By analyzing the Qing Dynasty Archives in National Palace Museum, we found the deployment and fighting experience of them. Furthermore, we recreate the history and the vessel's features by scaled wooden model and 3D model.

Aleš MATERNA | UNIVERSITY OF OSTRAVA, Czech Republic

Patents, licenses and new technologies applied in the ship production of the Vitkovice Mines, Steel and Ironworks Corporation for the Austro-Hungarian Navy, 1891-1914

This work deals with the analysis of ship production material in Vitkovice Ironworks, which belonged to the company's main production activities in period 1891 - 1914. In this period, new patents and licenses for the production of armor plates purchased from companies Harvey, Krupp and Carnegie played an important role in the development of the company. The company's transition to the production of war material was determined by tense atmosphere in international relations and new trends in warfare. Military material during this period became popular and very profitable commodity production. For the company that is involved in such arms, this production promised large government contracts and excessive earnings. For Vitkovice Mines, Steel and Ironworks Corporation was easiest to enter competition in the manufacture of armor plates for the construction of naval forces. This production fully met the business objectives of enterprise management, which was led from 1876 - 1893 by one of the best metallurgical experts of Austria, Paul Kupelwieser. He constantly acquainted with technological innovations in steel production in the European steel industry centers (Sheffield, Middlesborough, Essen) and the most important inventions applied in Vitkovice Ironworks. Through the transfer of information and monitoring of technological development, that were obtained by Vitkovice ironworks in the period 1891-1914, Vitkovice succeeded to get a monopoly on the production of marine armored plates and marine armored turrets for the entire area of the Habsburg monarchy. Vitkovice Ironworks were also involved in the construction of dozens of battleships, cruisers and 4 dreadnought (the most famous of them was Viribus Unitis), which fought in the World War I. The aim of the presentation is not only to describe the mentioned production activity, but also to present other important aspects linked with this issue such as: the creation and expansion of operations and investment in development, the acquisition of know-how, new patents and licenses, competition with other arms companies, the technological development and implementation of new processes in steel production and supply of ship material.

John Laurence BUSCH | Independent Historian, United States

'It would have been thought chimerical': testing first-generation steamboats, water by water

In view of the Conference's sub-theme of "sites and geographies of knowledge-production and knowledge-exchange," I offer the following paper and presentation: Title: "It Would Have Been Thought Chimerical": Testing First-Generation Steamboats, Water by Water When American inventor Robert Fulton successfully ran his North River Steam Boat as a regular passenger service along the Hudson River in 1807, he demonstrated that it was possible for humans to alter artificially where they were, and when they were there, to practical effect. No other invention had yet accomplished such a thing, making "steamboats" the first high technology in history. But Fulton's initial success was limited to the Hudson River. It remained to be seen whether these fragile contraptions could be employed successfully on other bodies of water. This presentation will provide a descriptive analysis of how the first generation of steamboat entrepreneurs rapidly and methodically tested (or not!) this first high technology on: —rivers; —canals; —lakes; —bays; —sounds; —and finally the ocean. Chronologically, the paper will cover the period from 1807 to the early 1820s, which can be considered the timeframe for the first generation of steam-powered vessels. The presentation also will show why steam-powered vessels should be considered the first high technology, and how this new definition of the term can be used to fundamentally alter the way we view the history of technology. I will happily entertain Q&A for as long as time allows. PLEASE NOTE: this proposal is in addition to a different proposal submitted to ICOHTEC, which has not yet advised as to whether my proposal to their Symposium has been accepted. If it is, I shall respectfully withdraw this proposal.

T201-B. Aeronautics and infrastructures

Wed 24 July, 11:10–12:40 • Uni Place 4.214

Chair: Jon AGAR | University College London, United Kingdom

Takehiko HASHIMOTO | University of Tokyo, Japan

Research on the boundary layer and the invention of the laminar flow airfoil in Japan and the United States, 1930-1945

This presentation will comparatively analyze the historical process of the invention and development of the laminar flow airfoil in prewar Japan and the United States. Itiro Tani, the Japanese aeronautical engineer at Tokyo Imperial University, studied boundary layer and based on its aerodynamic research, proposed the design of the laminar flow airfoil. The American engineer Eastman Jacobs at NACA also designed the laminar flow airfoil, a few months prior to the Japanese design. Both of them relied on the idea proposed by the British engineer B. Melvill Jones on the possibility of retarding the transition point from laminar to turbulent boundary layer over the wing surfaces. After knowing the results of Jones's investigation, American and Japanese engineers independently took similar paths of the development of the new airfoil. They diverged, however, in the subsequent manufacturing process of producing wings: While the Americans successfully manufactured precisely shaped and polished wings, the Japanese had difficulty in manufacturing such wings. I will show and discuss these historical processes of the invention, development, and construction of the laminar flow airfoil in both countries.

Gordon DADSWELL | University of Melbourne, Australia

Wooden propellers: the de Havilland Aircraft Company and Australian wood science, a symbiotic relationship

British aeroplane manufacturer de Havilland had long been engaged in making wooden propellers in England when the company established operations in Australia in 1927. From 1930 De Havilland Australia manufactured metal and wooden propellers as well as the DH82 Tiger Moth and from 1943 the DH98 Mosquito. The woods used for both aircraft and propellers were imported from the United Kingdom or North America, mainly due to the company's ignorance of the properties of Australian wood. Their specific concern was the use of Australian wood for propellers, particularly for the Tiger Moth but also the Beaufort, Wirraway, and Mustang. To overcome this lack of knowledge de Havilland entered into what can be identified as a symbiotic association, starting in 1933 and continuing strongly from 1941 to 1944, with the Council for Scientific and Industrial Research-Division of Forest Products. This paper explores the nature of this symbiosis, not reflective of biological or socio-biological characteristics but defined as independent agents functioning co-operatively. In order to demonstrate the presence of a symbiotic association between the two entities, certain attributes are identified: place - laboratories and non-laboratories; activities undertaken - tasks, goals, and products that are conceived, developed, and created; temporality of the relationship - frequency of co-operation and the time taken to complete activities; connectivity characteristics between entities - identifying the processes used; resistances encountered; and the ramifications for each organisation of the symbiotic association. Analysis is conducted through close reading of archival sources against the attributes, except emerging resistances that are analysed using Andrew Pickering's methodology, the 'dance of agency', whereby human and non-human resistances are 'tuned' in order to achieve outcomes. The result of the analyses confirms that a symbiotic association between de Havilland and the Division of Forest Products functioned between 1941 and 1944. Furthermore the methodology used suggests potential as a tool to identify symbiotic associations between organisations which are not interdependent, that appear to have little in common, but which work co-operatively.

Michael KAY | University of Leeds, United Kingdom

The dark side of counterfactual history: reappraising the historiography of early British telephony

This paper exams historiographical issues arising from a study of the early history of British telephony. Greg Radick (2008) has pointed out that when formulating and exploring truth claims, historians, like scientists, employ counterfactual thinking, asking 'what if x had been different?' Such conjectures are useful for considering issues of causality. How we employ counterfactual thinking has been the subject of several recent articles (Radick et al., *Isis*, 2008, Soler et al., *Studies in History and Philosophy of Science*, 2008, Shapin, 2007).

However, whilst much emphasis has been placed on whether or not counterfactual thinking can be helpful within the history of science, little has been written about the ways such thinking can sometimes be dangerous to historical enquiry. I argue that Charles R. Perry's 1977 essay, 'The British Experience 1876-1912: The Impact of the Telephone During the Years of Delay' is a good example of this.

Perry formalised the idea that, during the period covered, the progress of British telephony was held back. However, I argue that this thesis, which has been very influential in subsequent scholarship, has itself held back our understanding of the history of telephony. Perry made an unhelpful counterfactual assumption, namely that there existed an ideal way in which British telephony should have developed; he then interpreted the fact that it did not follow this model as evidence of a 'delay' which requires explanation. This tacit methodological counterfactualism led him to problematise the low uptake of the telephone during this period

instead of seeking to understand why people decided to use telephones in the first place.

Perry's essay is not alone as an American economic history of technology which misrepresents the development, proliferation and use of certain technologies outside the US. Other examples include Martin Wiener's 1981 book *English Culture and the Decline of the Industrial Spirit, 1850-1980* and Thomas Hughes' 1983 book *Networks of Power: Electrification in Western Society, 1880-1930*. I argue that we must compensate for the methodological bias of these studies in our contemporary histories.

Using material from the British Telecom Archives in Holborn, London, and periodical sources to suggest an alternative narrative to Perry's, this paper illustrates how taking a normative instead of a positive approach to counterfactual history can result in misleading narratives, and suggests a way to rectify this.

Lu GAO | Institute for the History of Natural Science, Chinese Academy of Sciences, China

The making of the metropolitan: the sociotechnical development of the Beijing Metro System

The building of Beijing Metro System was a different story comparing with other modern cities which aimed at the making of 'metropolitan'. The first metro line in Beijing was built in late 1960s under the guiding ideology of war preparedness. Premier Zhou Enlai said 300 busses would be sufficient for the transportation of Beijing in 1960s, so the building of the metro was mainly for the purpose of war. The passengers were seldom considered during the design and construction, so after 10 years of the buildup of the metro line, only very few people visited the underground with official permissions. In the perspective of ANT, the goal of building the metro was successfully translated by the government and party leaders. The enrollment of the engineers, citizens, also the tunnel trail into the network helped building up the image of a well-equipped China.

After the Opening and Reform, Beijing became one of the biggest cities in China. More population in the city need to be commuted. The metro system was built as a new market experiment and the prosperity of the new institution. The act-ants involved in the network had been changed into private companies, government supervisors, passengers and the new electronical operation system. With the expanding metro system, Beijing became a genuine Metropolitan.

This paper will lead us to a few interesting conclusions, for example, the distinctive implications of a metro system to Beijing in different historical background, and the shaping of heterogeneous network. The paper also attempts to bridge the methodology crack between history of science and STS by applying the ANT as a historical analysis approach.

T201-C. Knowledge transfer in universities and industry

Wed 24 July, 14:10–15:40 ▪ Uni Place 4.214

Chair: Imogen CLARKE | Independent scholar, United Kingdom

Katherine PLATT | University of Manchester, United Kingdom

Moving light industry into the north of England: Siemens during the interwar period

This paper will discuss the activities of the engineering company Siemens in the north of England during the interwar period. Historiographical approaches to industry in interwar Britain consider the global depression, industrial rationalisation, the decline of heavy industry in the north, and the establishment of lighter industries in the south. While Siemens was impacted by problems in the wider economy and also merged with other businesses as a means of addressing these

problems, its move away from heavy engineering and into electronics in fact led to a move into the north, to a large, well-established site of heavy industry at Preston.

In discussing industry during the interwar period, historians, while acknowledging geographical shifts in manufacturing, have paid little attention to the changing industrial make-up of the north, the resulting impacts upon the companies operating there and the changing identities of both the region and the companies themselves. This paper aims to tackle these issues by exploring the reasons for Siemens' move into lighter electronics and into the north.

These issues require an approach which scrutinises not just economics and politics but also the identities and meanings of the industrial north, incorporating ideas of place and power. The paper will draw upon a diverse range of sources, from company minute books to policy documentation, trade literature and local newspapers. It will include discussions of geography, policy, regional culture, and identity to show that, by the end of the inter-war period, Siemens and representatives of the town of Preston and its surrounding region reciprocally used each other to promote their own interests. This has interesting implications for our knowledge of the place of Siemens in the changing landscape of the industrial north and the networking of the whole country for electrical power.

Hilz Helmut | Deutsches Museum, Germany

The knowledge base of industrial research: the rise and decline of the industrial library

Western Europe, the German-speaking countries, and the United States saw a rapidly rising number of scientific and technical publications since the beginning of the 1850s. In Germany the first technical periodical came into being in 1820. Until 1935 the number of technical reviews grew to a worldwide total of 15.000.

The rise of the scientific and technical literature resulted from the growing importance of science and engineering studies at the universities and engineering schools. Since the end of the 19th century, however, also engineers and scientists of private companies published more intensively.

Yet, at the same time scientific and technical literature became more and more important for companies of the science-based industries like the chemical and the electrotechnical industry. Moreover, mechanical engineering, mining, and steel-production saw an increasing need of literature. At the beginning, each department of such companies was responsible for accessing the required written knowledge. This was no longer possible around the 1890s, when most of the big and also some mid-sized companies began to build up industrial libraries. These libraries had a scientific character and often developed into leaders in the field of subject indexing. For engineers and scientists a fast access to the content of scientific periodicals was both crucial for their daily technical routines and for economic activities like patenting.

The paper examines the role of industrial libraries in the development of industrial research and their importance for the daily work of primarily science-based companies. The paper raises a number of overarching questions such as: Why did companies of the chemical and electrotechnical industries but also of some other industries from 1890 onward build up libraries bigger than the libraries of some big engineering schools? What were the differences in the management of written knowledge between private industry and academia? What was the content of the collections? Who worked in these libraries? How did industrial libraries affect the development of other scientific libraries?

Laila ZWISLER | Technical University of Denmark, Denmark

University-industry transfer: the cases of indoor climate technology and Möesbauer spectroscopy

This paper will address two cases in the 70's and 80's involving scientific research, technology and industry. The centre of the study is the Technical University of Denmark (DTU) and what is generally portrayed

as stories of success of that university. The main focus of this paper is the technology developed by Thomas Lund Madsen in the field of climate research.

In 1970 DTU indoor climate scientist P.O. Fanger published a thesis on thermal comfort, which presented an equation expressing the sensation of comfort of a human being depending on six thermal parameters and indexes for personal comfort, all based on climate chamber research. Through his work Fanger wished to make of the knowledge of thermal comfort operational and quantify human sensation. Fellow DTU researcher Thomas Lund Madsen developed measurement equipment based on the research by Fanger. A central method for Lund Madsen was to construct sensors as the human body. Over time this equipment turned into two different types of commercial products – the small Comfytest and the life size thermal manikin. The relations between the spheres of university and industry were close as both humans and artefacts spanned both domains.

In the field of climate research Fanger became somewhat of a superstar, while his contemporary Lund Madsen was largely invisible. When the story of indoor climate research at DTU is told generally we get detailed information about the research of Fanger, a short mention of apparatus developed on the basis of the research and an equally short mention of the apparatus turning into commercial products. The aim of my study has been to find out what is hiding behind the one-liners about apparatus and industry.

Following the artefacts and other main actors I have explored different in and out fluxes to and from the process based on interviews, archival material and historical objects. In the paper I will tell the story of the instruments and how different communities of practice formed and changed. Many different types of knowledge were unified in the apparatus.

This is contrasted by another 80's DTU success story. The centre of this story is equipment for Möesbauer spectroscopy. This equipment was made for basic research in physics at DTU. Here again a community formed with close links to industry. Again I have followed both artefacts and other actors, but this time it was not a commercial product which was transferred into the commercial sphere. It was a human being.

Johannes-Geert HAGMANN | Deutsches Museum, Germany

From Leipzig to Harvard: knowledge transfer in early UV spectroscopy

2013 marks the 100th anniversary of the publication of Niels Bohr's atomic model which for the first time successfully explained empirically known features of hydrogen line spectra. The results of spectroscopic research on hydrogen of the late 19th and early 20th century have been key elements for the foundation of modern atomic theory. A precondition for the determination spectroscopic series beyond the visible optical domain has been the development of novel experimental and instrumental expertise on the properties of ultraviolet and infrared radiation.

The first line spectrum of hydrogen ($n=1$ in Rydberg's formula), which today bears the name of its discoverer Theodore Lyman, is entirely located in the ultraviolet domain. Measurements of the UV hydrogen spectrum had been first extended by the retired German engineer and amateur spectroscopist Victor Schumann in Leipzig through improvements in photochemistry and the elimination of UV absorption sources in the optical path.

Schumann's extensive personal and scientific correspondence covered more than 200 hundred scientific experts, instruments makers and editors including William Crookes, Carl Zeiss and Josef Maria Eder. His work however, which was credited by contemporaries including Lyman who refined and extended Schumann's research, is today widely unknown.

Using sources from the archives of the Deutsches Museum and the Bibliotheca Albertina, this paper analyzes Schumann's research as a case study for knowledge transfer in two distinctive dimensions: i) the transcontinental transfer of scientific expertise from Germany to the USA, and ii) the transfer of technology from a self-trained and mostly self-funded individual to the world of academic research.

T202. Information technology, communications, networks

Sat 27 July, 09:00–10:30 ▪ Uni Place 4.204

Chair: **Richard NOAKES** | University of Exeter, United Kingdom

Marcelo VIANNA | Pontificia Universidade Católica do Rio Grande do Sul - PUCRS, Brazil

Para além dos clones – a formação do campo da Informática no Brasil nos anos 1980 através de três casos de fabricantes de microcomputadores (1980-1988).

Em que pese a importância dos computadores na vida contemporânea, há poucos estudos sobre a formação do campo da Informática brasileira. Boa parte centrou-se no impacto da Política Nacional de Informática (1984) através da reserva de mercado, mecanismo protecionista que visava desenvolver uma indústria genuinamente nacional de computadores e periféricos a salvo da concorrência das grandes multinacionais (IBM, Hewlett-Packard). Estes estudos, no entanto, acabam por privilegiar uma dimensão política do processo, deixando de lado outras possibilidades de análise. Nosso trabalho pretende trazer outro enfoque – o estudo de casos de microcomputadores no mercado nacional brasileiro; para isso, iremos apresentar três fabricantes nacionais: Codimex, Microdigital e Unitron. O primeiro trata dos limites de uma pequena empresa situada na periferia do mercado nacional; o segundo, uma das empresas que maior sucesso teve no mercado nacional, mas que fracassaria na transição ao mercado de computadores de 16 bits; e o terceiro, de uma empresa de grande porte que seria alvo de uma forte disputa com a Apple Computers em torno do clone do Macintosh (Unitron Mac 512). Ao analisar a trajetória desses fabricantes, esperamos discutir outros elementos que compunham o cenário da Informática brasileira dos anos 1980, como a formação de um público consumidor de Informática e as possibilidades de sucesso ou fracasso dos fabricantes em contexto de crise econômica e constante transformação tecnológica.

Beyond clones: the building up of the Brazilian information technology field in the 1980s through three cases of personal computer manufacturers, 1980-1988

In spite of the importance of computers in modern life, there are few studies about the formation of Information Technology field (IT sector) in Brazil. Most of them focused on the impact of "Política Nacional de Informática" (IT National Policy) – 1984 that created the protected market. This IT Policy was a protectional mechanism which aimed to develop a genuine national industry of computers and peripherals free from the competition of large multinational competitors (IBM, Hewlett-Packard). However, these studies favoured a political dimension of the process, putting aside other possibilities for analysis. This paper intends to bring another approach: a study case of three national microcomputer manufacturers: Codimex, Microdigital and Unitron. The first one, Codimex, deals with the limitations as a small manufacturer in the market; the second case,

Microdigital, which is also a manufacturer that has achieved a great success in the national market but failed in the transition to 16-bit computer technology; and the third one, Unitron, a major manufacturer that had a large dispute with Apple Computers over a Macintosh clone (Unitron Mac 512). Analysing the outcome of these manufacturers we will discuss other issues that made up the scenario of Brazilian IT in the 1980s, such as the arising of the IT consumer market and the manufacturers' chances of success or failure in an economic crisis context and under constant technological changes as well.

Advait DESHPANDE | The Open University, United Kingdom

Learning from failure: the knowledge at work with ISDN, ATM, MAN, QAM/CAP and WiMAX

Does a technology ever fail? The history of telecommunications in the last 30 years has a number of examples of technologies and institutionally funded initiatives such as Integrated Services Digital Network (ISDN), Asynchronous Transfer Mode (ATM), Metropolitan Area Network (MAN), Quadrature Amplitude Modulation (QAM)/ Carrier-less Amplitude Phase modulation (CAP) and Worldwide Interoperability for Microwave Access (WiMAX) that can be deemed commercial failures. Despite their apparent failure, though, these technologies played a significant part in technologies such as Digital Subscriber Line (DSL), Internet Protocol (IP), Ethernet, Data Over Cable Service Interface Specification (DOCSIS) and Long Term Evolution (LTE) which have seen or are likely to see strong adoption in the real world and are considered commercial successes. This paper examines the circumstances in which the preceding technologies failed and how the knowledge gained from their failures played a part in other technologies developed around the same time or subsequently. Purely in terms of technical attributes, each of the preceding technologies has played a significant part in the subsequent developments. Taking a more rounded view, the paper looks at the extent to which the failure of the preceding technologies is socially constructed and whether such an understanding could ever be considered completely accurate. The paper will draw from archival material and first-hand testimony from various industry-based participants to establish the historical events and the outcomes for each of the technologies being considered. This analysis will derive influences from Kenneth Lipartito's discussion about the social meaning of failure in relation to the Picturephone, Melvin Kranzberg's Laws and Andrew Feenberg's ten paradoxes of technology.

BAO Ou | Institution of Science Technology & Society, School of Social Sciences, Tsinghua University, China

翻译工作在中国计算机起步中的作用 (1953-1967)

中国计算机研究起步于1953年。在西方全面封锁的背景下，苏联政府从文献、设备和人才培养等方面对中国计算机研发给予了帮助。1958年中国仿造苏式M-

3小型计算机制出103机，1959年仿造苏式БЭСМ-

II大型机制出104机。从1960到1967年，中国相继制造出107、109、109-2、109-

3计算机，奠定了中国计算机未来发展的基础。其间，及时、准确、大量的翻译工作为中国计算机发展早期能够快速发展提供了重要保障。但是在以往中国计算机发展史研究中翻译工作的作用几乎没有被关注。本文通过介绍中国计算机早期发展中的翻译家（例如：于桂芝和张伟夫妇）及其工作成果，拟说明翻译作为科学技术的传播媒介，不仅直接影响科

技传播的效果，体现出其科技史的价值，而且对于科技史编史学研究具有重要意义。

The role of translation in China's starting development of the computer, 1953-1967

Chinese computer research started in 1953. Suffered from the comprehensive blockade of the Western, the Soviet government offered help of various aspects, from the literature, equipment to personnel training. In 1958, China developed the Computer 103 that imitated from Soviet M-3 micro-computer, and in the following year the Computer 104 which copied the Soviet-style БЭСМ-II macro-computer came into being. From 1960 to 1967, China had developed Computer 107, 109, 109-2 and 109-3 successively, laying the basis for further development in the field of computer making. In the meantime, a large amount of timely and accurate translation work provided an important guarantee for the rapid development of Chinese computer at early stage. However, previous studies paid little attention to the indispensable role of the translation during the development of Chinese computer. This study focused on the translators (such as Guizhi Yu & Wei Zhang couple) who had made great contribution to the computer development at that time as well as their translation works, in order to illustrate the author's point that translation, as a kind of media, not only impacts the results of science & technology communication, but also embodies the value of history of science & technology. Moreover, the study of translation is of important significance to historiographical research.

Scott CAMPBELL | University of Waterloo, Canada

Computation centres, configured users and early computer technology in Canada

In my talk I will discuss the creation and evolution of the first national computing service in Canada from the mid 1940s to the late 1950s in Canada. In particular, I will argue in favor of a user-driven framework to understand the position of computing centres as a mediator between technology and user. Most historians have portrayed computing centres differently: as statistical or mathematical laboratories extending well back in to the 19th century; as the home of high-speed large-scale computer hardware development from the 1930s to the 1950s; or as the birthplace of computer science in the 1960s. These accounts tend to emphasize the technological advances or professionalization of computing labour; only a few have considered a whole relationship between the technological hardware, computing centre and its end-users.

No major scientific computing centre existed in Canada until the late 1940s, although many had existed in the U.K. and the U.S. for many years. In 1948, the University of Toronto, with the support and blessing of several government and military research agencies, created the Computation Centre as a national computing service for Canadian scientists and engineers. Initially, the Centre was equipped with electromechanical calculators and served a small set of relatively passive clients with unremarkable computational needs. However, in 1952 it acquired the first electronic computer in Canada, a Ferranti Mark I from Manchester, and immediately faced numerous challenges acquiring the new skills to use the machine and communicating the new knowledge to its clients. Critically, this latter group was expanding with curious non-scientific end-users who would actively shape computing practice. Throughout the 1950s as the Computation Centre constantly and continually mediated between the shifting social and technological demands, configuring users and reconstructing the technology as necessary at an unstable boundary.

T203. Technical cultures of practice and knowledge

Sat 27 July, 09:00–17:30 • Roscoe 1.007

T203-A. Pre- and early-modern texts and technologies

Sat 27 July, 09:00–10:30 • Roscoe 1.007

Chair: John C HENRY | University of Edinburgh, United Kingdom

Tracey RHILL | Swansea University, United Kingdom

Mechanization in the ancient Greek and Roman world

Machines powered by human or animal muscle, by water, by air, by steam, and by falling weights were employed in Greek and Roman agriculture, quarries and mines, manufacturing establishments, service businesses and homes, either to make tasks easier to perform or allow them to be performed at all. Knowledge about them was formed and disseminated in writing. Known books on machinery include those written by Agesistratos, Arkhimedes, Arkhutas, Demokles, Diphilos, Diades, Ktesibios, Kharias, Numphodoros, Philon of Byzantion, Poluidos and Purrhos.

The Antikythera Mechanism may be sidelined by skeptics as highly unusual but that cannot be said of other ancient machines. The pragmatic deployment of mechanical aids in ordinary life is attested in various domains. For example, orthopedics is a transparent branch of medicine, insofar as it is not hard to identify a dislocated joint or fractured limb, and good words and placebos are not enough to restore function. Brute force is required. Since Hippokrates' time that force was typically supplied either by a couple of strong assistants or by machines that stretched the human frame to allow the doctor to manipulate the bones back into place. The Hippocratic bench was joined by other mechanisms large and small, often bearing the name of their developer, such as Andreas' engine, Pasikrates' spanner, and Aristion's chest. Nymphodoros' chest, an endless screw mechanism in a little box, enabled doctors to exert and control significant force with little fuss and less display.

Machines for moving and lifting loads took priority over machines for war and entertainment in Philon's *Mechanical Compendium* of ca 200 bce. Heron chose not to describe "many kinds of presses that have been in use in great numbers for a long time among the common people" because they were less effective than the lever and screw presses that he did discuss and analyze (*Mechanics* 3.20); clearly there was more variety on the ground than is recorded in his work, as we should expect of any technology. His rhetoric may be misleading, but effectiveness was his declared priority, which refutes a common modern presumption that ancient authors on mechanics attended to the theoretically most complicated or novel devices.

Hossein ALIZADEH GHARIB | Independent scholar, United Kingdom

Opposition to Aristotle's meteorology: textual evidence from the Qur'an

In Aristotelian meteorology the sublunar region was the realm of the four essential elements of earth, water, air and fire. Interactions of these four elements were thought to account for such natural phenomena as meteors, comets, and the Milky Way in the upper atmosphere, clouds, lightning, rain, winds, storms and rainbows in the lower atmosphere, and rivers, seas, earthquakes, salts, metals, and stones on and under the Earth's surface.

There is some evidence which suggest that about the onset of the religion of Islam the pagan Arabs had adopted a modified version of Aristotelian meteorology to explain the occasional fall of meteorites through the Aristotelian theory of lightning. In this early Arabic tradition, the meteorites were considered as an atmospheric phenomenon, created due to accretion of wet and dry exhalations which were contaminated by earthy particles.

The atmospheric accretion theory was later reinvented independently by the Persian natural philosopher Avicenna in order to explain his personal observations and experiments on several meteorite falls of his time. The evidence for exactly how the early scholars reached the conclusion that Aristotelian theory of lightning can be used to explain the meteorite falls, and the nature of the modifications introduced into Aristotle's theory, is found in the early Arabic translations of the *meteorology*, which most probably were not directly made from the Greek manuscripts, but possibly through intermediary Syriac commentaries on Aristotle. The evidence from Qur'an suggests that manuscripts of these early Syriac commentaries were probably available in Arabia from as early as the 6th century CE.

As this study suggests there is substantial evidence in the Qur'an and other Islamic sources to conclude that the "atmospheric accretion" theory of meteorites (aerolites) was raised by pagan Arabs of Mecca in opposition to another rivaling theory, endorsed by Qur'an, about the celestial origin of the meteorites. Both of these theories are presented in the current research, through a study of manuscripts and printed original sources.

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Brant VOGEL | Selected Papers of John Jay, United States

Weather and time: the link between early-modern meteorology and technologies of time

On January 12, 1684 William Musgrave in Oxford wrote with excitement to Francis Aston at the Royal Society of London that they had found a drawing of Cornelius Drebbel's perpetual motion in the Bodleian Library, a copy of which exists in the letterbooks of the Society. In Musgrave's account, Drebbel and his clock were embraced as being of their scientific program. Such clock had been thought of as ancestral to Sir Christopher Wren's design for a weather clock, and the weather clock that had just been realized by Robert Hook. Also in 1684, Dr. Martin Lister introduced the first meteorological graph to the same circle, plotting instrumental readings against time. The engine of Drebbel's c. 1603 clock was, in fact, a form of Galileo's weather-glass.

Since the very beginning of instrumental meteorology, the new philosophical instruments were seen in conjunction with the measure of time, just as time and weather happily coincided in the common almanac. This not only reflects the practicalities of early attempts at understanding changes in the weather, but also a deeper connection, where *weather* is, in essence, the way Western Europeans experienced *time*. This paper will trace this relationship through the course of the 17th century.

T203-B. Skills, knowledges and practical work

Sat 27 July, 11:00–12:30 ▪ Roscoe 1.007

Chair: Trevor LEVERE | University of Toronto, Canada

Baisakhi BANDYOPADHYAY | Indian National Science Academy, India

The evolution of traditional ecological knowledge in India: an overview

Many traditional societies, often referred to as indigenous or tribal people, have accumulated a whole lot of empirical knowledge on the basis of their experience while dealing with Nature and natural

resources. This traditional wisdom is based on the intrinsic realization that man and Nature form part of an indivisible whole, and therefore should live in partnership with each other. This eco-centric view of traditional societies is widely reflected in their attitudes towards plants, animals, rivers, and the earth. With biodiversity concerns having been pushed upfront, in more recent times, in the context of global change, traditional ecological knowledge (TEK), encompassing all issues linked to ecology and natural resources management has assumed greater significance. An assessment of TEK in India shows that it encompasses several fields, namely, sustainable forest management, biodiversity conservation by sacred groves, sacred landscape and sacred plant species, crop management, farm management, animal management and therapeutic role of Ayurveda. There is a rich trove of religious and nonreligious texts available in different centres in India that deal with these aspects of TEK and these include Kautilya's Artha-sastra (321-296 BC), Mahabharata (c.3000 BC), Ramayana (c.5000 BC), Rigveda (c. 8000BC), Krishi-Parashara (c.400 BC), Kashyapiyakrishisukti (800 AD), Vrikshayurveda (c.1000 AD), Krishi Gita (c.1500 AD). The current research paper is a journey from the early concept of Traditional Ecological Knowledge and Natural Resource Management and it examines how traditional ecological knowledge (TEK) is taught and practiced today among Native communities of India. Of special interest is the complex relationship between indigenous ecological practices and other ways of interacting with the environment, particularly regional and national programs of natural resource management. TEK is important for its own sake and for its social and cultural values. But, it is also significant for a number of practical reasons, many of them relevant to Biodiversity Conservation, because it offers new biological knowledge and ecological insights and some TEK systems provide models for sustainable resource management. The use of TEK is often crucial for development planning and it may be used in environmental assessment. The current paper gives a clearer insight into these practices. It may be possible to underline the need to culture and propagate some of these practices for better environmental protection in modern times.

Yufeng REN | Inner Mongolia, China, China

在艺术的文化语境中解读地毯手工技术的“民族性”变迁

地毯、挂毯手工编织技术起源、发展于中国少数民族地区，一直被定位为民族工艺。在进入西方的市场和文化圈后，被看作“一类有趣而珍贵的异国物品”、东方地毯、承载“他者”文化意义的符号，并持续地给予特殊关注。我们也一直将其作为自己“民族”的工艺，西方又作为“他者”民族的工艺。“民族性”是东西方对地毯、挂毯强调的一个点。那么，这里的“民族性”是如何体现的呢？我们以内蒙古地区的地毯、挂毯编织技术的发展历史为例，研究发现，在艺术的文化语境中地毯、挂毯手工技术的民族性也发生了变化，或者说，事实上，一直被称为“民族工艺”的这项技术在其发展中是走向“去民族性”的过程。

地毯、挂毯手工编织技术起源的民族性。最早出现在内蒙古少数民族地区,反映游牧民族的生活方式和观念。编织技术针对的是少数民族的需求,生产原料也来源于内蒙古的纯绵羊的春天和秋天的羊毛,弹性好,毛长,能够保证地毯、挂毯的质量。以后,由于改良羊的毛短且弯曲,开始从新疆、河北等地采购羊毛原料。从原料上也脱离了起源的民族地域性。在小作坊生产时期,本地区有充足的男性劳动力,50年代后

，转化为女性职工，分布于周边的牧区、农区。地毯生产直接依赖于本地的劳动力优势，在这一点上将其称为民族性不如地方性更恰当些。

手工技艺和工艺的民族性。地毯、挂毯的手工编织从简单的生产过程发展成为复杂的生产技术体系。其中，区别于其他编织类型最关键的地毯打结方式是手工操作。与其他少数民族不同，内蒙古生产地毯采用倒“8”字马蹄扣打结扣的传统土耳其方式，这个传统手工编织方式一直采用着。在生产工艺方面研制出新的手段和工序。但20世纪50年代后，基本上不是直接对外销售而是接单生产，销往国外，设计和生产是根据国外消费者的文化、心理、观念、生活方式、习俗等的要求来研制新工艺。尽管从事于这一领域活动的各类人员，反复强调其民族性，根据我们的调查，其实，更多的是体现在管理者、设计者、生产者的感情、心态和立场上，将其作为民族工艺在经营着，保护着，传承着。近年来，新建的中国地毯小作坊，又将处于低谷或即将消失的地毯、挂毯手工编织技术复兴起来，地方政府也将其作为民族工艺在政策上给予扶持着。

其实，在生产理念、图案的设计，市场导向上走向去民族性过程。

设计图案的民族性。消费者对图案的要求是图案设计的前提。日本、俄罗斯、美国、英国等不同文化背景的消费者对色彩、图案有着不同的偏好，所以，设计者在在借鉴、吸收的过

关键词：文化 少数民族 地毯 手工技术 民族性

The changes of national character of handmade carpet technology in the cultural context of the artistic

Carpets and tapestries, the hand-making products dated back to Chinese minority areas, have been positioned as a national process. While Chinese see them their own, Western think them other national items when entering the markets. Both Chinese and Western focus on the national character of the carpets. How the carpets reflect the national character? Take the example of the technology development of Inner Mongolia carpets to find out. As a result, the national character has changed much. Actually the known national craft has get away from its national character during development.

The hand-woven technical originated in the Chinese national character. They first appeared in Inner Mongolia. It is the minorities demand that urge the prosperity of the carpets. The raw material came from Inner Mongolia. The wool of the pure sheep here, which is famous for its elasticity and length. Later, due to the low quality of the wool, the raw materials transported from other places. So the materials get away from its original national character. This region had adequate male labor force. After 1950s, most of the labor force changed into female. The carpet production is directly depended on

local labor advantage. At this point, it will be more appropriate to call local character than national character.

The national character of craftsmanship .The production systems of craftsmanship are changed from simple to complex. It is the manual operation that stands out among other types of carpet knotting. Inner Mongolia unique way of weaving had begun with a traditional Turkish invert eight word horseshoe buckle to knot. Later carpets were sold aboard by orders other than by sales. The design and production changed much. Many facts have shown that the national character matters much, if so, according to our survey, designers and producers' ideas matter more. These help protect and develop the crafts. Recently the newly built workshops have helped rebuilt the disappearing enterprises with the help of the local government technology policy. The designs of the national character. The consumer is the premise. Foreign countries have different preferences. In order to cater to their demand, the way of design is getting away from national character, too.

Wiepke VAN AAKEN | Future Cities Laboratory, Singapore

The contested craft: brick-making in Singapore

In 2005 the last three Singaporean brickworks were demolished leaving no tangible trace of a craft that had shaped the city. In research, two aspects of brick production have been reviewed so far. One focuses on underlying power relations of colonial brick-making, the other on the productivity of the labour intensive craft in post-independence production. Surprisingly missing is a perspective that relates brick production to the internationalisation of building knowledge. The material arrived in Singapore in the course of colonisation when the brick-making craft had gained momentum through evolving industries in Britain. However, the imported frost resistant British bricks were without benefit for the tropical climate. On the contrary, while vernacular structures of timber and attap had long provided breathable buildings, the solid, heavy bricks blocked natural ventilation. Never the less, bricks became the dominating building material. This paper aims to trace the imposition of bricks for the Singaporean urban development till the beginning of the 19th century. A research approach was chosen that used a simplified model of action and reaction. For the British part of actors, imported machines and experts, measurements of implementations like regulations, taxes and training were identified and analysed. Also, colonial search for an alternative, equally fire resistant material was investigated. The process of reaction was traced to understand whether the various stakeholder groups with their respective brick-making traditions considered an adapted material in terms of size, weight and composition that responded better to the tropical environment.

As a result, the paper found that bricks indeed rendered the Western influence physically visible, but were manufactured in a broad range of techniques imported from Europe, India, China and the two Straits Settlements equally. In the manufacture process adjustments to local conditions of supply and craft knowledge were found. Adaptions of the bricks to local climate could not be verified, the process was instead shifted to the development of building typologies. An imposition of the material remains however indisputable.

Throughout the developed world, bricks largely lost their significance for the construction sector. Mechanisms of the building industry still lead to large imports of inadequate building materials that continuously add to the Singaporean cityscape of high rise glass towers. As the story seems to repeat itself the understanding of the driving forces gains relevance.

Juan Luis DELGADO | Universidad Autónoma de Madrid, Spain

The creation of resin tappers in Spain in the nineteenth and twentieth centuries

The resin industry in Portugal and Spain is looking to profit the current situation of the international resin market, in which China has decreased the export of resin's by-products (turpentine and rosin) to Europe so the prices have reached a level that make possible to consider the recovery of the industry in these countries. In Spain municipalities, regional governments, research centers, industrials, old resin tappers and, recently, the Ministry of Agriculture are working together. One of its goals is training young people to tap a pine tree. This communication is a part of my PhD thesis which focuses on tapping and processing of the natural resin in the Spanish pinewoods during the 19th and 20th centuries. In this sector technology has played a key role to industrialize this traditional activity in some areas of the Castilian plateau. However since the industrial demand of resin's by-products during the first half of the 20th century was very powerful other pinewoods in other provinces (of the same pine specie: *pinus pinaster*) were exploited with this end. This enterprise needed a labor force with very specific skills that locals did not have. Hence, the people of these towns had to learn a new trade with the help and instructions of those who learned before in the northwestern region of the province of Segovia. In that province, the experience in tapping living pine trees was one of the eldest and the only one that survive through the times (in other regions was practiced during specific situations of necessity). Consequently, as the activity became industrialized since the beginning of the second half of 19th century and new tapping techniques were imposed by law (1865), on one hand the reaction of locals was fierce against the foresters who desperately forced them to learn and apply it, and, conversely, on the other hand foresters needed to negotiate with old tappers in order to keep them working with their own tapping technique. Otherwise fires would have been unrestrained and robbery of forest resources common. Nevertheless the information about the transfer of this kind of knowledge is neither precise nor substantial. In the available sources –official forests documents, demographical statistics, local newspapers and company records– the topic is nearly suggested. However, I consider the information could be enough to perform the story of the creation of resin tappers in Spain.

T203-C. Contexts of innovation

Sat 27 July, 14:00–15:30 ▪ Roscoe 1.007

Chair: Tracey RIHLL | Swansea University, United Kingdom

Mohammad Israrul HAQUE | Aligarh Muslim University, India

The importance of technology and innovation: lock manufacturing at Aligarh

The LPG and WTO regime has hit the Small Scale industry very hard and Lock industry of Aligarh has been feeling the brunt of it. Even International Centre for Advancement of Manufacturing Technology (ICAMT) of UNIDO's effort through National Programme for Development of Indian Lock Industry could not reverse the declining trend of Aligarh Lock industry. According to the District Industries Centre records, there are about 1,100 registered lock-manufacturing units at Aligarh. However, an unofficial survey puts the figure at 12000 including 1,100 registered units. The industry employee around 200,000 people and cater to 70 to 80 per cent of the domestic requirements. The city itself is known as city of locks. The Aligarh artisans developed unique locks known as "Aligarh Trick Locks" and Sparkling Patent Locks". They manufactured them through traditional methods and followed lever lock technology. In fact the locks were initially brought by Johnson and Company from Great Britain and Germany and sold at Aligarh and later manufactured locks at Aligarh some two hundred years ago. The two artisans Karim Elahi and Nabi Bakhsh in the year 1818 manufactured forged iron hand made locks at Aligarh. Most of the lock industry workers in Aligarh have been working in the sector for generations. In old Aligarh City, every third house will have someone working in the lock industry. Most artisans have no specialised training, and simply learn on the job. Some of the educationally qualified bigger players engaged in

manufacturing mechanised Lever and Pin Cylinder type locks are said to be doing better business than the traditional lock makers. What has given them an edge is mechanisation, improved methods, large scale production and marketing. The smaller players and artisans too need to cope with technological changes and employ better methods of production to reduce input cost and supply goods at competitive prices to both domestic and international market to survive in the industry in future.

Matteo SERAFINI | University of Bologna, Italy

Teams, tools and expertise: technological innovation in the Italian packaging industry, 1960-1998

Mass consumption was made possible, among other things, by the introduction of customized, automatic packaging machines – in charge of manufacturing various kinds of packages that have fundamental transport, commercial, and hygienic functions for the trade of a wide range of consumer goods. In the second half of the 20th century Italy became the second world-producer of this machinery after Germany, and the local compartment established in Bologna became the main manufacturing centre in the world. The classic economic literature described the Bolognese packaging sector as a sort of industrial district (e.g. Capecchi, 1997), characterized by the development of a pool of technical knowledge shared among the local technicians. Yet, limited in-depth attention has been devoted until now to the establishment and evolution of the different corporate technical communities present within the district, and to their peculiarities. The present paper is a first attempt to probe into one of the main local corporate communities, analysing its evolutionary pathway in terms of concrete learning processes, pool of knowledge, skills & tools, work organization, external collaborations, and innovation practices. The company singled out is G.D S.p.A., one of the three world-leaders in the production of tobacco packaging machinery. The focus is on G.D's technical design office considered in the period 1960-1998 and on its invention and innovation work on one of the company's most successful products (the G.D cigarette packer). The study relies both on primary corporate documents and personal communications of G.D designers. First of all, it results that four generations of designers contributed to and participated in a shared pool of knowledge & skills that over the years emerged as a distinctive endowment of the G.D's technical design office. Secondly, the paper highlights that in the 1980s and the 1990s the innovation practices of the technical design office depended especially on the improvement of its fundamental problem-solving capabilities – which led to the redefinition of the internal work organization and of the identity of this technical community. This case study suggests a more heterogeneous picture of the technical personnel working within the Bolognese packaging district, claiming for a more in-depth analysis of the various local technical communities and of their interactions in order to understand the innovation capabilities of this compartment.

Heiller ZÁRATE ARBELÁEZ | Universidad Nacional de Colombia, Colombia

Julio Cesar AMAYA | Universidad Nacional de Colombia, Colombia

La Válvula de Hakim: ¿Por qué se inventó en Colombia y no en los centros de cálculo de la época?

La comunidad científica colombiana e internacional, al igual que los medios de comunicación colombianos, han ensalzado, con justicia, a Salomón Hakim como uno de los científicos más destacados de Colombia en el siglo XX, por el "descubrimiento" del Síndrome de Hidrocefalia de Presión Normal y la invención de un artefacto tecnológico para el tratamiento de la hidrocefalia. Parte de la alabanza proviene del misterio que provoca lograr un desarrollo científico en un país científicamente periférico. ¿Cómo pudo ser que en un país como Colombia, en la década de los 60's, se produjera un desarrollo científico

de tal magnitud? Las historias sobre la Válvula de Hakim, o deberíamos decir, las historias sobre las múltiples Válvulas diseñadas por los Hakim, de forma muy valiosa han narrado la secuencia de hechos ocurridos desde la década de los 60's respecto a Salomón Hakim y su herederos científicos, a través de un discurso progresivo, que deja abierta la pregunta al por qué en Colombia, y no en otro lado, se produjo la invención y el descubrimiento inicial. Esta pregunta cobra más valor en tanto "Colombia" refiere a la "periferia". Así pues, la pregunta se aguza: ¿por qué en la periferia y no en los centros de cálculo? Nuestra investigación se orienta a responder esta pregunta, a través de los conceptos de Marco tecnológico, Inclusión y Flexibilidad Interpretativa, propuestos por Bijker en el paper "The Social Construction of Bakelite: Toward a Theory of Invention" (1989). Adicionalmente, a través de esta investigación pretendemos deconstruir el concepto de "periferia".

The Hakim valve: why was it invented in Colombia and not in centers of knowledge?

The Colombian and international scientific community, like the Colombian media, have lauded justly Salomon Hakim as one of the leading Colombia's scientists in the twentieth century, thanks to the discovery of the Normal Pressure Hydrocephalus Syndrome and the invention of a techno-scientific device for treatment of hydrocephalus. Part of the praise comes from the mystery that causes achieving a scientific development, of that magnitude, in a scientifically peripheral country. How could it be, that in a country like Colombia, in the early 60's, there were a scientific development of such magnitude? Stories about Hakim valve, or should we say, stories about the multiple valves designed by Hakim Family, have narrated, very valuable, the sequence of events since the early 60's about Salomon Hakim and his scientific inheritors through a progressive discourse, which leaves open the question why in Colombia, and nowhere else, there was the discovery and initial invention. This question is more value as "Colombia" refers to the "periphery". So the question is sharpened: why in the periphery and not in knowledge centers? Our research aims to answer this question through concepts of Technological Frame, Inclusion and Interpretative Flexibility, proposed by Bijker in the paper "The Social Construction of Bakelite: Toward a Theory of Invention" (1989). Additionally, through this research we want to deconstruct the concept of "periphery".

This presentation is based on work co-authored by Carlos Andres Arroyave Bernal.

T203-D. Science and technology across boundaries

Sat 27 July, 16:00–17:30 • Roscoe 1.007

Chair: Matteo SERAFINI | University of Bologna, Italy

Pu CHEN | Harbin Institute of Technology, China

Research on the process of the steam engine's introduction into China

Steam engine is an important mechanical invention in the industrial revolution. With the Western Learning, steam engine is gradually introduced to China. The first book who introduced the principle of the steam engine is the Eastern Western Monthly Magazine which is edited by Guo Shila. After then a number of books of the steam engine have appeared in China. Ding Gongchen also made a steam engine model. Xu Shou made the first steam engine of China in 1862. It encountered many difficulties in the process of steam engine was introduced into China, including the lack of engineering and technical personnel and the machines tools. The officials of Qing government addressed these problems through the purchase of Western equipment and the hiring of

foreign technicians for technical training of workers. Since then, with the deepening of the Westernization Movement, the technology of steam engine was gradually spread in China.

Feza GÜNERGUN | Istanbul University, Turkey

Instructing the native apprentices in Istanbul: British mechanics in the Imperial Gun Factory of Tophane, 1869-1874

The sending of the Imperial Engineering School (Istanbul) graduates to European industrial plants for training and the hiring of foreign engineers, mechanics and foremen were the two major stratagems that the Ottoman government relied on for the modernisation of Ottoman weapon industry in the 19th century. The aim was to train the qualified native labor and gradually decrease foreign dependency. The first group of graduates sent to Europe in 1834 included Halil Efendi who was trained in the Royal Arsenal Woolwich in London. Back to Istanbul, he was assigned to the Imperial Gun Factory of Tophane where he administered from 1863 until his death in 1873 with a brief break. During his governance, Halil Pasha invited several British mechanics to contribute to the production and improvement of weaponry in the Gun Factory.

A group of British foremen arrived in late 1868 headed by the engineer John Mackenzie. Soon after their arrival, Halil Pasha asked Mackenzie, who by then had taken charge of the Gun Department, to introduce a system for teaching the native staff the art of "practical mechanics". Mackenzie suggested the payment of a certain remuneration to foremen-instructors, the apprentices and servicemen. The instruction commenced on 1st September 1869. When any of these native staff shall attain the first, second and third degree of proficiency (each of 2 years) which shall be equal to *onbaşı* (corporal), *çavuş* (sergeant) and *mülazım* (lieutenant), the instructor was to receive £ 5, 10 and 15 per head, respectively. The instruction was carried on successfully but the payment of the promised remuneration was repeatedly postponed by the Tophane administration despite Mackenzie's petitions, who himself was eventually dismissed together with the eleven English employees following the death of Halil Pasha in 1873.

Halil Pasha, despite his willingness to improve gun and cannon production in Istanbul, to train native apprentices by foreigners and thus to diminish foreign reliance, does not seem to have succeeded to overcome Ottoman bureaucracy and treasury. This short term experience in instructing mechanics at the Tophane foundries is indicative of the Ottoman standpoint in technical training. The present paper aims to introduce and analyse this experience within the context of Ottoman modernisation of gun production and manpower development.

Hajime MIZOGUCHI | Risho University, Japan

The influence on Japanese zoology of foreign zoologists who visited Japan before World War II

In the present study, the author classified three groups of zoologists who visited Japan before World War II to know their contribution for the establishment of Japanese zoology.

The first group was the zoologists who stayed in Japan to teach the knowledge and research method for Japanese students. They were American zoologists, such as E. S. Morse, C. O. Whitman and R. Goldschmidt. The second group was the zoologists whose main aims came to Japan are collection of animal specimen, zoological material s for researches. They were German zoologist, F. M. Hilgendorf, American ichthyologists, D. S. Jordan and B. Dean, herpetologist, L. H. Stejneger, and collectors of butterflies, Pryer, M. A. Fenton and A. Owston. The third group was the zoologists who did not come to Japan. However, they investigated, named, and classified Japanese zoological specimen. They were P. Bleaker, the Netherlands, A. Gunther, United Kingdom, and F. Steindachner.

Among them, the author noticed the scientific activities and their impact of Japanese zoology done by L.H. Stejneger (1851-1943) and R.

Goldschmidt(1878-1958). Stejneger was born in Norway. He has been interested in birds. After he graduated from Christiania University, he moved to the US. He worked at Smithsonian Museum in 1881. He belonged to the department of ornithology in 1884 and herpetology in 1899. He visited Japan in 1896. Then, he got acquainted with Japanese zoologists. He described 163 species in his book Herpetology of Japan and Adjacent Territory in 1907. Goldschmidt was famous for the idea of Hopeful Monster, a kind of biological evolution. He was born in Frankfurt. He came to Japan in 1914 to collect his biological materials including a kind of moths. Later, this material contributed to the establishment of physiological genetics. From 1924 to 1926, he lectured at College of Agriculture, Tokyo Imperial University. He taught genetics for students. He returned to Germany and studied at Kaiser Wilhelm Biological Institution. In 1936, Goldschmidt defected to the US. and took the professor position at the University of California, Berkeley. His reprint collections and academic books were transferred to Japan. They were useful for the establishment of National Institute of Genetics in 1949.

T204. Science and technology museums in context

Wed 24 July, 09:10–12:40 ▪ Uni Place 4.212

T204-A. Science and technology collections in museums

Wed 24 July, 09:10–10:40 ▪ Uni Place 4.212

Chair: Robert G W ANDERSON | Clare Hall, Cambridge, United Kingdom

Emily WINTERBURN | University of Leeds, United Kingdom

Brand-name chemistry: the chemical museum at the University of Leeds

This paper introduces a previously unstudied collection of some 2000 chemical samples collected between around 1870 and 1960 and held at the University of Leeds. Chemical museums such as this one are rare, because samples of this kind were always viewed by the chemists who used them as disposable materials. Also, they have historically held little interest to the collector. Yet, for historians they offer a rare glimpse into the day to day workings of a typical turn of the century chemical laboratory. This collection unusually has survived and, as I will argue in this paper, offers tantalising clues as to how chemistry was done in the late 19th and early 20th century, and in particular, how a university such as Leeds related to and interacted with surrounding industry and the broader scientific community.

The collection includes material from well known international brands such as ICI and Boots; it contains material relating to Robert Bunsen and to the 1876 HMS Challenger expedition, yet these connections have never previously been explored. The collection also contains material relating to local Leeds industries, to colour chemistry and the textile industry, to building materials and to local chemical manufacturers.

This paper is a presentation of the very early stages of what will hopefully become an extended research project on this collection. It looks at some of the problems involved in trying to turn a poorly documented collection of 3D artefacts into the subject of a coherent research project. This is research that takes the object, or rather a collection, as the starting point, and looks for clues in that collection that will in some way inform our understanding of some of the broader stories in the history of science.

As a starting point to this research, this paper looks at the Leeds chemical museum collection within the context of other related collections – the colour museum collections in Bradford for example and

the HMS Challenger collections at the British Museum. It also considers other, non-object based research on this history of chemistry in the university in this period to establish what the key questions a study of this kind might hope to address.

Hermione GIFFARD | Independent Scholar, Netherlands

Exhibiting jet engines: how museums write history

The world's first jet aircraft flew during the Second World War and the first jet engines entered museum collections not long after. The display of early jet engines in technical museums changed over the twentieth-century, as the engines were fit into new narratives reflecting contemporary concerns, and in this way, the history of the jet engine has been created and recreated in the public sphere. In this paper, I will trace the history of the acquisition of early jet engines by the Science Museum in London, the Smithsonian National Air and Space Museum in Washington D.C. and the Deutsches Museum in Munich. Each museum came by their early jet engines in different ways and each presented them to national audiences with very different relationships to the British and German inventors or co-inventors of the jet engine, Frank Whittle and Hans von Ohain. In Britain, Whittle was an important post-war national hero. In the United States, where both inventors lived by the mid-1970s, the two men invented a machine that was perfected by Americans. In Germany, the first public celebration of von Ohain did not take place until 1980. Through their authoritative displays, leading museums not only disseminate but also create knowledge about the history of technology. By virtue of the public authority behind these accounts, museum exhibits are a focus point for different interests - scholarly, political, engineering. Recognizing this, various communities have sought to shape museum practice in different ways. The changing aviation exhibits at the three leading museums discussed in this paper thus reflected not only changing museum practice and varying museum goals but also distinct and changing national discourses about identity, technology and technological museums.

Elisabete PEREIRA | University of Évora, Portugal

From private collecting to university knowledge: networks for communication and scientific dissemination

In 1913, the Portuguese Ethnological Museum became part of the Faculty of Humanities, University of Lisbon. Its collections became an educational resource for the improvement and expansion of the University's "higher intellectual culture". Given that private collectors are crucial for building collections of national and university museums, this presentation addresses the relationships between academic knowledge and collectors' practices. Antonio Paes da Silva Marques (1876-1950), a former administrator of the Avis county and a deputy for Elvas during the first republic, was one of such collectors. A former student of Escola Politécnica (Polytechnic School) of Lisbon and a frequent correspondent with the Director of the Portuguese Ethnological Museum, Antonio Paes was one of the local influential personalities. He offered and promoted the donation of collectors' pieces to the museum, hence contributing to the enrichment of museum collections and to the development of explanatory theories on the production of objects during the Neolithic Period. Focusing on his intellectual experiences, namely on the relationships between private collecting and the academic world, we will identify Antonio Paes cultural and scientific practices through the analysis of networks and channels for science exchange; this will enable us to draw conclusions on the path travelled between "collectors curiosity" and the dissemination of scientific culture in academia through university collections. Particular attention will be given to the trajectory of some pieces collected by Antonio Paes that were presented at the International Congress of Archaeology in 1912.

T204-B. Museum, history and nation

Wed 24 July, 11:10–12:40 • Uni Place 4.212

Chair: Aileen FYFE | University of St Andrews, United Kingdom

Hirota YAMADA |

Rakuno Gakuen University, Teacher Training Center, Japan

The Coalmine Eco-Museum Establishment underlain by the historical perspective of Hokkaido and Japan in the modernization era

1) Historical state of Hokkaido in modern Japan Hokkaido Island is located in the northern part of Japan. In its exploitation, in Pre-Meiji era, they had restricted in the coast regions of Hokkaido, after 1870 year (Meiji 2), Kaitakushi, one part of Meiji Government, made a large scale finance from the big social economical companies, Mitui, Mitubishi, Sumitomo, and introduced the big technology (so to speak colonial exploitation technology) from USA, and therefore succeeded a rapid development of Hokkaido consequently. 2) Hokkaido coal mines under the continuous development for 100 years In 1890, Yubari coalmine was opened (Hokkaido Tankou Kisen, 2nd scale in Japan). After that for about 100 years, Akabira (Sumitomo), Bibai (Mitubishi), Sunagawa (Mitsui), Ashibetsu (Mitsui) (these are center of Hokkaido), Yubetsu (Mitubishi)-Kushiro-Taiheiyo (Mitsui) coalmines were opened respectively and they reached amount of 120 coalmines in number. 3) Technological characteristics of coalmining in Hokkaido and production share in Japan Their technological characteristics were the large scale production (2mil. ton per year), deep shaft (1000m under surface), high power winding motor (3000hp over), water purifying machine, full electric system, these big coalmine companies, by using of big finance (Mitui etc) and USA and Germany coal mining technology imported, succeeded a regional enlarged technology establishment in Hokkaido consequently. Annual production share of Hokkaido coalmines was 30% of Japan (before world war II), according to technological development, Hokkaido coalmine companies reached 60% (after world war II), and high performance of coal mine technology in Japan (world level). But under the policy of the energy exchange by Japan government after 1970's, many coalmines (over 900 coalmines) were closed except Kushiro-Taiheiyo coalmine and many coalmining equipments were demolished rapidly. 4) Conclusion In order to maintain and preserve and re-use these Japanese only one Hokkaido heritages (ex Yubari (largest coalmine museum), Ponbetsu (largest shaft in Asia), Haboro (only one winding tower), Akabira (most useful shaft in Japan) as a system heritage, author underline that it is necessary to make a preservation method as Taipei coalmine museum and establishing of the national collaboration system among study society, government (national and regional), preservation group, sightseeing company as our enterprise (Sorachi-Yama-nokioku Jigyou as Eco-Museum and action network for 15 years continuing).

Sara ÖSTLUND NILSSON | The National Library of Norway, Norway

Hunting for independence and bringing home knowledge of the tropical world to Norway

Over a century ago, when Norway was still in union with Sweden, a strong wind of exploration and a wish of independence blew over Norway. Strong minded and brave Norwegian polar heroes challenged the harshest conditions known on earth, for the sake of science, exploration and fame. By challenging the coldest places on earth they were also heating the growing nationalism in their country. Today, snow, polar bears and *Aurora borealis*, still plays an important part of the nationalistic identity of Norway. What is less known is the story of the Norwegian tropical explorers from the same period, whose achievements strangely has ended up in the shadows in comparison to the polar heroes. Here I aim to shed some light on three quite unknown men, Jacob Iversen, and the two brothers Hans and Andreas Kamstrup and their remarkable experiences while hunting and collecting exotic

animals for the Zoological Museum in Christiania. I will also highlight the deeper political objectives behind the construction of an extensive museum collection that had the ambition to also include exotic tropical animals. Putting it lightly one may say that these men were "hunting for an independent Norway". To understand more about this process, one has to look a couple of hundred years back in history, long before museums were established. Biological collections, could be enjoyed either at menageries, were alive animals were at display, or samples might be exhibited in "cabinets of curiosity" often belonging to kings and nobles. In these settings the sole purpose of a collection where to "show off" the owners own social position in society. However, when museums were established in the 19th century, the aim with biological collections shifted from solely being for entertainment to becoming essential for educational and scientific purposes. Although the aim of a collection was transformed through history, the status still remained. It was no longer solely executed by "the few and wealthy", but by the entire nation. In Norway, this nationalistic status was used to finally break free from their union with Sweden.

Marco STELLA | Faculty of Science, Charles University in Prague, Czech Republic

'What can anthropology do for the nation...?' The Hrdlička Museum of Man (established 1937) between public education and nationalism

For the past decade, attention has been paid to the relationship among anthropology, medicine, eugenics, nationalism and the in central and eastern Europe during the first four decades of the 20th century. However, the questions whether and how this interconnected set of ideas (and ideals) was presented to the public seems to be rather unexplored. This paper will introduce some ways in which anthropological, medical and eugenic knowledge was transmitted to the Czechoslovak public between 1918 and 1939. The scientific knowledge of the human species was not only used to underpin Czechoslovak nationalism, but also, based on the personal level of professionals involved in these efforts, served as a public expression of the international political orientation of the Czechoslovak state. Both of those tendencies found a clear expression in the design and exhibits of the Hrdlička Museum of Man of the Charles University in Prague, which was for the first time open to the public in 1937. The museum was financially supported and its concept developed by Aleš Hrdlička (1869-1943), a prominent U.S. physical anthropologist with Czech origins and with strong sentiments for his fatherland. The displays of the museum were practically created by Czech anthropologist and Charles University high official Jindřich Matiegka (1862-1941). Hrdlička furnished Czech anthropologists with rare anthropological material from the Americas, became a popular figure for the Czech public and starting as early as 1912, he also funded with moderate (and in time increasing) sums projects dealing with Czech (Slavic) anthropology, archaeology and history. The opening of the museum can be understood as the culmination of the Hrdlička-Matiegka cooperation, which also had a strong political aspect. E.g., it was Hrdlička who helped to set the ethnic and national borders for the new state of Czechoslovakia in 1918, being personally very close to T.G. Masaryk, the first Czechoslovak president, during his exile in the U.S. Hrdlička and Matiegka created a mixture of anthropological, archaeological, demographical and ethnographical displays, which were linked with the common idea of Czechoslovak (Slavic) racial, cultural and national superiority. Next to the presentation of other ways of the transmission of anthropological knowledge to the public (journals, books, newspapers etc.), the paper attempts to reconstruct the design and contents of the museum's displays between 1937-1939.

T210. Islamic science and medicine

Sat 27 July, 16:10–17:40 ▪ Uni Place 2.219

Chair: Francesca BRAY | University of Edinburgh, United Kingdom

Taner EDIS | Truman State University, United States

Flights of fancy: the 1001 Inventions exhibition and popular misrepresentations of medieval Muslim science and technology

The 1001 Inventions traveling exhibition (London, Istanbul, New York, Abu Dhabi, Los Angeles, and now Washington DC) displays a representative sample of popular myths about medieval science and technology in Muslim lands. A prominent example is its claims about human muscle-powered flight achieved through wings constructed by the 9th century Andalusian Ibn Firnas and the 17th century Ottoman Hezarfen Ahmet Çelebi. These feats have very poor historical documentation, and a simple scaling argument shows the virtual physical impossibility of such achievements. Yet not only are beliefs about the flights of Ibn Firnas and Hezarfen common among Muslim populations today, they have been endorsed by the engineers and historians associated with the 1001 Inventions project. The myth of medieval Muslim flight serves as a case study illuminating how the history of science in Muslim lands has been fashioned into a narrative supporting present needs for technological modernization. This narrative, however, also supports a revival of medieval ways of thinking about nature, and is an obstacle to improving the poor state of natural science in Muslim-majority countries.

Sonja BRENTJES | Max Planck Institute for the History of Science, Germany

Do we need our professional organizations to have a policy towards popular presentations of our research?

Do we need a policy of IUHPS towards popular presentations of our research?

This paper raises a crucial issue -that of our responsibility towards the misrepresentation of our research in public spaces by popular organizations or individual amateurs. The reason for proposing a debate about the need of a policy adopted by IUHPS is situated in my negative experience to stimulate a public debate with major public organizations such as the Science Museum in London or National Geographic in D.C. as well as our own professional organizations about the heavy distortion of research results on the histories of sciences in Islamic societies by the exhibition 1001 Inventions and its accompanying book presentations.

In my paper, I will present first the policy pursued by 1001 Inventions and the scholarly claims made by its organizers. I will then illustrate the organizer's deviation from their claims in favor of very simplistic and ideologically grounded distortions of the past with a few of the most glaring examples. I will situate this abuse of history of science in shortcomings of our own academic practices. I will argue that the failure of our professional organizations to formulate policies towards the popular representation of our research and to encourage members to actively participate in translating their research for the broader public in a manner that does not distort the past by any kind of distorting narrative is partly responsible for today's abysmal situation. I will show that these ideologically grounded misrepresentations of our research permeate by now large parts of public spaces (the Internet, major newspapers, popular books, TV and film productions). This raises several problems, in particular for our students, but also among larger communities across the globe who mistake such popular fantasies for 'truth' and build political as well as cultural beliefs on them, that we have to take seriously and confront in an active manner. My principled stance is that we do not only have a responsibility for the quality of our research, but also for its use and abuse in public spaces and the consequences arising thereof.

This presentation is part of a larger book project that will bring together colleagues from different fields of history of science and art history as well as museum curators to discuss these problematic issues of how to present complex historical phenomena for the broad public without distorting the past.

Rainer BROEMER | Fatih University Istanbul, Turkey

Revisionist popularisation of the history of science: 1001 Inventions and Muslim heritage

Academic historians of science have always been confronted with politically expedient appropriations of historical research. The line between academic and popular history is obviously fleeting, but in the recent past, the global political conjuncture and a more rapid distribution of contents over the internet have led to a steep increase in the spread of claims that do not stand up to the most basic scholarly standards. This paper presents a case study concerning alleged priorities of the Muslim world in the medical sciences, exemplified by several exhibits in the exhibition '1001 inventions - Muslim heritage', which has been endorsed by the National Geographic and is reaching an audience of hundreds of thousands through museums, print and video, hegemonising the international discourse including some university-level teaching. Firstly, the reception of the 1001 inventions narrative will be traced through various types of academic, semi-academic, and popular media. This includes peer-reviewed journals in the history of science, SCI-indexed medical and healthcare journals as well as magazines published by national research organisations such as Turkey's TÜBİTAK and some authoritative-looking websites (e.g., muslimheritage.com). Even among active members of the International Commission on History of Science and Technology in Islamic Societies, there is no unanimity about an adequate presentation of research in this field or regarding appropriate responses to the growing visibility of revisionist historiography. An assessment of some of the recent public debates about the 1001 inventions project and some additional examples from the history of medicine in the Islamic world forms the second major part of the presentation. Finally, I will argue that as professional historians of science we need to strike a fine balance between concentrated research and thorough analysis on the one hand and contributions to the making of knowledge outside our immediate field of specialisation, either by publishing work that is accessible to a wider audience (non-specialist teaching, media, exhibitions, such as 'ex oriente lux?' in Oldenburg 2009) or through collaboration with media professionals (one would like to think of the National Geographic as a potential partner).

Commentary: Marina TOLMACHEVA | Washington State University, United States

Congress opening ceremony and keynote

Event code: **A391**

Mon 22 July, 08:45–10:30 ▪ Uni Place LT A and B

This plenary session marks the formal opening of the Congress. It includes speeches from Professor Liu Dun, President of the [IUHPS Division of the History of Science and Technology](#), and Professor Dame Nancy Rothwell, President of the [University of Manchester](#), to welcome our 1700 delegates to the Congress, the University, and the city of Manchester.

Professor Hasok Chang, President of the [British Society for the History of Science](#) – iCHSTM's hosting body – will then deliver the BSHS Presidential Address.

Keynote

Hasok CHANG | University of Cambridge, United Kingdom

Putting science back into the history of science

Many commentators have expressed the worry that the actual content of science is neglected in much of the recent work in the history of science. Conflicting attitudes on this issue have produced some unproductive and misguided divisions in our field. I wish to advance a thesis that is at once controversial and obvious: there is a distinct set of objectives in the history of science that cannot be met if we do not engage with scientific knowledge itself and with the methods used by scientists in pursuit of knowledge. Moreover, such objectives can only be fully met if our engagement with science is critical, based on the historians' own epistemic judgements that are independent from the current scientists' judgements. These conclusions are enhanced and enriched when we consider the functions of history in general, and how they may best be served when science is our object of historical study. What I envisage is not a revival of old-style internalism, but the flourishing of a mature discipline of the history of science that takes science seriously both as a socio-cultural phenomenon and as an epistemic practice.

IAHS keynote address and prize award ceremonies

Event code: **A392**

Thu 25 July, 14:00–15:30 ▪ Schuster Rutherford

Professor Samsó's keynote address will be followed by the award ceremonies for the prizes of the International Academy of the History of Science:

Alexandre Koyré Medal, 2013

The Alexandre Koyré Medal is awarded every two years by the International Academy of the History of Science for a scholar's career contribution, rather than for a particular achievement.

The medal is awarded to distinguished scholars who profoundly marked human knowledge and universal culture. Its past winners are:

D.T. Whiteside (1968); A.P. Yushkevich and his collaborators (1971); B. Suchodolski and collaborators (1971); L. Geymonat (1974); M. Clagett (1981); C.C. Gillispie and his collaborators (1986); J.D. North (1989); R. Rashed (1991); W. Shea (1993); J. Vernet, J. Samsó and the school of historians in Al-Andalus (1995); R. Taton (1997); J. Heilbron (1999); I. Bashmakova and C. Houzel (2001); *Storia della scienza*, initiated by V. Cappelletti (2003); G. Beaujouan (2005); E. İhsanoğlu (2007); the ESA

History Project, directed by J. Krige and A. Russo (2009); B. Hoppe (2011).

Prize for Young Historians, 2011 and 2013

The Prize for Young Historians rewards a first work in the history of science.

Keynote

Julio SAMSÓ | Universitat de Barcelona, Spain

Al-Andalus (Islamic Spain) as a bridge between Arabic and European science

The main trend of transmission of Arabic science to Christian Europe in the Middle Ages took place through translations made in Spain during the 12th and the 13th centuries. In theory the entire Arabic corpus of writings until the 12th century was available, though only a selection of it was actually translated. We may wonder what criteria the translators used to make their selection. In this lecture I will put forward my own hypothesis, which is that of a historian of Andalusian science who is **not** an expert in the translation period.

The lecture will focus on the following points:

In order to be translated into Latin or Castilian, texts had first to be available. This means that only books which had reached al-Andalus in the 12th century could be translated. An analysis of several standard lists of translations (works by Gerard of Cremona listed by his *socii*, translations undertaken for king Alfonso X of Castile, Arabic works translated into Hebrew by Jewish translators from Languedoc and Provence in the 13th and 14th c., etc.) shows that the selection was purely chronological. Eastern Arabic books produced before the end of the 10th century had reached al-Andalus and could be translated. With a few exceptions, such as the work of Ibn Sînâ and Ibn al-Haytham, the later Eastern production never reached the Iberian Peninsula, and was not translated; later Arabic texts, written in the 11th and the 12th centuries, were translated only if they had been written in al-Andalus.

This fact can be explained in the context of the history of Andalusian science and culture. Since the beginning of the 9th c., the emirs and caliphs of Cordova had promoted a policy of orientalising of Al-Andalus. As part of this policy a large library was created in the royal palace, which reached its summit during the caliphate of al-Hakam II al-Mustansir (r. 961-976). Due to the existence of this library, a good part of the scholarly production of Eastern Islam up to that time was accessible in Cordova. After the fall of the caliphate ca. 1035, however, the policy fell into disuse. None of the kings of the *tawâ'if* (petty kingdoms) had any great interest in building a similar collection of books, or the economic capacity to do so; the only references we find are to specialised libraries like the one compiled by king al-Mu'taman of Zaragoza (r. 1081-85). The arrival of Eastern books in al-Andalus was interrupted towards the end of the 10th century. From the 11th c. onwards, Andalusian scholars seemed to believe that a student did not need to complete his education by travelling to the great capitals of the East and that the cultural level of al-Andalus was equivalent to that of Baghdad, Damascus or Cairo. Statistics show a major reduction in the number of 'journeys in search of knowledge' (*rihla fi talab al-ʿilm*) and first rate scholars such as Ibn Hazm, Ibn al-Zarqâlluh, Ibn Rushd or Ibn Zuhr do not seem to have travelled eastwards.

The lack of contact with Eastern culture and science affected not only the world of translators, but the history of Andalusian science as a whole. The golden half-century of the *tawâ'if* (ca. 1035-1085) saw a splendid flourishing of science in al-Andalus (mainly in the fields of Astronomy, Mathematics and Agronomy). From this period onwards, Andalusian science would develop on the basis of its own resources. This implied, on the one hand, a certain originality, but, on the other, a steady decline after the 12th century. One of the reasons for this decline was, no doubt, the almost total lack of contact with Eastern Islamic Science, which continued to be creative until, at least, the 15th century.

DHST and BSHS young scholars' prize presentations and Congress closing ceremony

Event code: **A399**

Sun 28 July, 09:30–12:00 ▪ Uni Place LT A and B

This final plenary session will showcase emerging talent in the history of science, technology and medicine, with the award of both the DHST's and the BSHS's prizes for younger scholars.

This year, the **BSHS Singer Prize** has been awarded to Iain Watts. The **DHST Young Scholars' Prize** was won by Michitake Aso, Eugénie Briot, Fabian Krämer, Don Leggett and Marc Oliveras, with honourable mentions to Hesham Alahmad, Hao Chen, Helen Curry, Yulia Frumer, and Li Hui.

We are delighted to report that seven of the award-winners will be attending to collect their prizes in person, and several (Aso, Krämer, Leggett, Oliveras) will give short presentations based on their work.

The Congress will then close with a short ceremony of thanks and farewell, and a look forward to the next Congress in 2017.

With contributions from:

Michitake Aso | University at Albany–State University of New York, United States

Fabian KRÄMER | Ludwig-Maximilians-Universität München, Germany

Don LEGGETT | University of Kent, United Kingdom

Marc OLIVERAS | Universitat de Barcelona, Spain

Helen Anne CURRY | University of Cambridge, United Kingdom

Li Hui | Shanghai Jiao Tong University, China

Iain WATTS | Princeton University, United States

E047. Historical and contemporary communications technologies in Africa: a case study in Cameroon and wider reflections

Wed 24 July, 09:10–12:40 • Uni Place 2.219

Special session organisers:

Charlotte CONNELLY | Science Museum, London, United Kingdom

Mirjam DE BRUIJN | Universiteit Leiden, Netherlands

In recent years, the urban landscape in much of Africa has been radically changed by the proliferation of mobile phone technologies. This rapid change not only reflects the way mobile technologies are developing today, but also provides the key to understanding the historical development of communications infrastructure in these regions. New kinds of knowledge are being generated and shared through organisations, such as recently founded mobile phone repairers' associations, and online.

The first session of this symposium will bring together several speakers who have worked in Cameroon, West Africa to document the changing landscape by a variety of means. The three presenters, alongside Walter Gam Nkwi, whose work we will also discuss, were brought together for a field trip to collect artefacts and interviews for a display in *Making Modern Communications*, a forthcoming gallery about communication and information at the Science Museum, London. The speakers come from a range of different disciplines, and papers will discuss the history of communication in Cameroon, materiality of mobile phones, the challenges of collecting contemporary material culture and the role of community groups in helping to gather and interpret this material for the museum.

The second session will be an interactive workshop investigating the role of participatory practices and work with communities in museums and in wider historical research. With a new wave of public focused research projects and calls for peoples' museums, peoples' collections and citizen science, the question must be asked, 'what does this mean for historical research practices in the future?' This workshop will explore what the risks and rewards of a participatory approach to historical research can be. The workshop will offer some differing points of view and invite delegates to question their own perceptions of participation and how it could affect their work. The session will open with a paper from Jessica Bradford, content manager for *Making Modern Communications*, discussing some of the challenges and benefits of this kind of work in a museum context.

The two sessions taken together will unpick some of the challenges of undertaking historical research in the recent past and at a geographical distance. In researching African mobile phone stories, the London-based *Making Modern Communications* team has found itself employing anthropological and participatory techniques to try and make sense of an otherwise hard-to-grasp topic.

E047-A. Generating knowledge

Wed 24 July, 09:10–10:40 • Uni Place 2.219

Chair: Jon AGAR | University College London, United Kingdom

Discussion

This session will include discussion of precirculated work by Dr Walter Gam Nkwi, a historian working at

the University of Buea in Cameroon, who has written extensively about the history of communication in the region. We will present some of his ideas to frame the later discussions around presenting and collecting Cameroonian communication culture in London's Science Museum.

Mirjam DE BRUIJN | Universiteit Leiden, Netherlands

The materiality of mobile telephony in Cameroon

When we embarked on a project to assemble an exhibition on mobile telephony in Africa the first question raised was: 'what is the materiality of mobile telephony?' In this paper I will scrutinise this materiality in several ways and from different perspectives. My point of departure is the visibility of the materiality, after all in a museum people have to 'see/observe'. Each technology comes with its regime that defines also the materiality. For instance the telephone companies have introduced new colours as part of their PR and they have introduced new advertisements published on big billboards, etc. Furthermore the technology demands a certain equipment like the antennae, the offices etc. These elements have certainly given the urban and rural landscapes in Africa a new view. Another materiality is the products that have come with the phone, the phones themselves. A new technology like the mobile phone will also come with special behaviour and attitudes of people who are now using these phones. Another materiality translates in the services, like repair shops, selling of airtime, etc. These elements together make the visuality and materiality of the mobile phone in Cameroon. These materialities came suddenly and change rapidly. Can we consider these materialities as popular culture or art? What is the perception of the 'users' of these 'intrusions' in their environment? What exactly does it represent, the peoples' culture or the companies culture?

Charlotte CONNELLY | Science Museum, London, United Kingdom

The challenges and rewards of building a museum collection of contemporary technology: the case of mobile telephony in Cameroon

The Science Museum presents technology stories from around the world in its galleries and exhibitions. However, the practicalities of collecting 3D material for displays often mean that collections are very UK centric. When the gallery team for the Museum's forthcoming *Making Modern Communications* gallery began development they knew that there would be some active collection of artefacts required for the more contemporary technologies, such as mobile phones. A very deliberate decision was made to include international perspectives, and after much deliberation Cameroon was selected as a case study. In order to tackle the problem of our UK heavy collection, plans were hatched for a collecting project including a field trip to Cameroon.

This paper will discuss the processes we went through to identify the objects we wanted to collect, and the practicalities of acquiring them and getting them back to the UK. Contemporary collecting is always a challenge as curators try to second guess what will in the future be regarded as important developments in the history of technology. Collecting in a foreign country to try and gather artefacts that are representative of that culture presents an even greater challenge. We drew on a range of people and organisations with expert knowledge to help us make our decisions, and had a well-defined 'wish list' of objects to collect by the time we travelled to Cameroon.

The Cameroonian case study represents the 'depth' in our museum display, but we also wanted to represent the 'breadth' of mobile communications around the world. This paper will finish by briefly describing some of the other international stories about mobile technology, and how we decided what would eventually be included in the display. One of the responsibilities for any curator undertaking contemporary collecting is to understand that in selecting what to collect and what not to collect, they are shaping the historical record for

researchers of the future. This is perhaps more true now than ever before, as our material culture becomes increasingly intangible and disposable.

Deanne NAULA | Science Museum, London, United Kingdom

Making modern communications: using participatory processes in exhibition development, working with the Cameroonian community in London and Cameroon

This paper will take a closer look at the process of participation and community engagement in developing a major new gallery at the Science Museum. It focuses on the representation of Cameroonians and their culture in a museum context.

The Science Museum's new gallery, *Making Modern Communications* puts people and their stories at the heart of its narrative. As part of this step change towards user-focused interpretation, we are also involving our audiences in the generation and framing of objects and content. One example of these stories is the emergence and resulting culture of mobile telecommunication in Cameroon. Many of the user stories, and unique perspectives on the experience of change, are held within the Cameroonian community. The museum decided to test a participatory methodology with the Cameroonian community in London to present this technological and cultural revolution in the most authentic way and deal with possible colonial preconceptions. This paper will explore the processes the museum went through with the community and participant group to build a collaborative team, and how the Museum's project team worked with both the London and Cameroon based community. It will also explore how the museum shared and adapted the standard museum processes and finally, reflect on the findings and lessons learned which will inform best practices.

E047-B. Using knowledge

Wed 24 July, 11:10–12:40 ▪ Uni Place 2.219

Chair: Deanne NAULA | Science Museum, London, United Kingdom

Jessica BRADFORD | Science Museum, London, United Kingdom

Telling the story of technological change 'in their own words': exploring participatory histories in the museum context

The Science Museum's new gallery, *Making Modern Communications*, will celebrate the vast number and range of people from the past and present whose lives have shaped, and been shaped by, information and communication technology. Our audience research shows that 'visitors are seeking to understand the impact of objects on people's lives at the time.' Our ambition is to present these impacts through real stories, first person accounts and authentic voices. Our objects are host to many memories; but how do we extract these stories, and how can they be woven into the fabric of the gallery, in harmony with historical context, technical detail and scientific content? Creating a people-focused gallery which connects visitors to their heritage in unique and powerful ways has opened new avenues for content research and development. Alongside more conventional research methods, the project team has collected diverse people stories through oral histories, witness seminars and a broad range of participatory activities. These activities have informed our decision-making at all levels, from object selection to label writing. This paper provides an overview of the process of content development for *Making Modern Communications*, focusing particularly on the opportunities and challenges of embedding knowledge gained through working with a range of groups and participants. This introduction will be followed by a practical workshop session which explores the benefits and potential challenges of participatory content development. We hope to gain feedback from historians about the role of first person experience

and tacit community knowledge within, and outside of, the museum setting.

With contributions from:

Mbeng Pouka, Cameroon community

Martyn Bennett, British Vintage Wireless Society

Gill Conquest, anthropologist

Dr Seraphin Kamdem, linguist, SOAS

E118. 40th anniversary symposium: the history of ICOHTEC

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Mon 22 July, 11:10–17:40 ▪ Schuster Bragg

Special session organisers:

Hans-Joachim BRAUN | Helmut Schmidt University, Hamburg, Germany

Timo MYLLYNTAUS | University of Turku, Finland

This session examines the series of symposia that the International Committee for the History of Technology (ICOHTEC) has held since 1968 and focuses on the general features of these meetings and the specific research topics that have been a recurring focus of scholarly attention. The themes under discussion include the planning and organizing process for the symposia, as well as their overall image in the context of the wider academic world, their social events, excursions, and informal conversations.

The aim is to discuss what kind of meetings the ICOHTEC symposia were at the beginning in the 1960s and 1970s, as well as how they have changed over the past decades. An important research issue is whether there has been anything that can be claimed as special or characteristic particularly to ICOHTEC symposia.

ICOHTEC was set up to build bridges to connect the divided world during a particularly 'freezing' period of the Cold War. Its founders realized that ordinary scientific communication was not enough; it was vital to enable participants to socialize with each other, to help them get to know other delegates personally, converse informally, and learn to understand each other, as well as to work together, despite possible ideological or political differences. In sum, the ultimate objective was to implement détente in science. In order to achieve these versatile goals, which exceeded the ones of ordinary academic meetings, ICOHTEC has put a lot of effort into maintaining the close transnational cooperation in preparing its scientific programmes, as well as into providing multiple social events with abundant opportunities for informal discussions. A conviction that chatting casually will guarantee that academic messages will be communicated has prevailed in ICOHTEC.

How has ICOHTEC managed to accomplish the mission for which it has received a mandate from the UNESCO? The aim of this session is to analyze answers to this question, as well as explain how the organization managed to find its place in the Big Picture, when the world changed after the end of the Cold War.

E118-A. Get socialised: ICOHTEC in the big picture

Mon 22 July, 11:10–12:40 ▪ Schuster Bragg

Session organiser: Timo MYLLYNTAUS | University of Turku, Finland

Chair: Hans-Joachim BRAUN | Helmut Schmidt University, Hamburg, Germany

Timo MYLLYNTAUS | University of Turku, Finland

Building up an image: ICOHTEC symposia as social construction

The International Committee for the History of Technology (ICOHTEC) held its first symposium in Paris in the turbulent year of 1968. At the time, the globe was divided into three worlds, which competed with each other in practically every field: the arms race, sports, culture, media attention, political influence, economic growth, science, and, at last but not least, technology. Historians of technology were not fond of this segmentation and confrontation. They believed that technology was universal and dependent on transnational cooperation. In order to express their willingness to collaborate over political boundaries, they founded ICOHTEC and started to build up an organization that aimed to promote understanding, cooperation, and recognition between scholars. To prove that they could do something tangible in the lines of their objective, they began to hold frequent symposia in different countries in both the West and East.

The image of an organization working for “peaceful co-existence” was the representation ICOHTEC wanted to construct for itself. At the time, governments in the East and West, the United Nations, and various other international organizations also tended to regard the history of technology as an important field for cooperation over boundaries. This paper aims to examine how ICOHTEC succeeded in achieving its goal.

The collapse of the Berlin wall, the USSR, and the Warsaw Pact meant the final end of the Cold War. Political barriers for international cooperation seemed to disappear. This also meant a turning point in the history of ICOHTEC, which was built out of the concept of the divided globe. The position of the national societies as the representatives of their countries soon lost significance within ICOHTEC, while individuals and informal research groups gained more importance. In the early 1990s this indicated the turn from internationalism to transnationalism in ICOHTEC, which had to update its image and take on a new orientation. The latter part of the paper deals with the measures ICOHTEC carried out to make its transnational turn and to take fresh directions forward.

The series of ICOHTEC’s 40 symposia can be examined as a survival story of cooperating and networking among scholars who have attempted to adapt to the changing constellations of world politics and to find their ways to promote goals that they have considered valuable and significant for their discipline and peoples of the globe.

Vasily BORISOV | Russian Academy of Sciences, Russia

Cooperation between east and west: history of technology in the USSR and the ICOHTEC

Formation of the Institution for the History of Technology in the USSR had been long and complicated. For the first time the Institute of the History of Science and Technology was founded in the Soviet Republic in 1932. It worked very actively, particularly in the field of the History of Technology. But the Institute was closed in 1938 after its director Nikolai Bukharin had been arrested and shot.

In September 1953 the Institute of the History of Science and Technology (IHST) was restored. Scholars of the Institute began research in the History of Technology in a wide range of problems with young enthusiasm. The Institute in general and technical departments, in particular, soon became the nucleus of the growing scientific community, which included investigators from many institutes of the Academy of Sciences and other organizations.

In 1962 a group of scientists of the Institute published a book, *History of Technology*, which has been formed, discussed, and polished up for more than seven years. One of the reasons for long work at that edition was the authors’ desire to eliminate some myths and deformations that had been characteristic of historical works published in the USSR in the

1940s and the early 1950s. Dr. Semyon Shukhardin, the leader of the team of authors, subsequently became as well a recognized leader among Russian historians of technology.

Shukhardin also paid attention to international scientific contacts and already in the 1950s organized regular contacts with historians of technology in the Czech Republic and German Democratic Republic. From the middle of the 1960s Shukhardin together with E. Olszewski, M. Daumas, and M. Kranzberg worked to realize the idea of an international society of the historians of technology that led to the creation of the ICOHTEC in 1968.

That activity had been supported by academician B.M. Kedrov, director of IHST, and by leaders of the Academy of Sciences. The International Congress of the History of Science, Technology, and Medicine in Moscow (1971), and the ICOHTEC Symposia in Kaluga (1976) became a real break-through for Russian historians of science and technology. All this have contributed to a rise of the history of technology in Russia. Marxist-Leninist ‘lining’, what H.-J. Braun paid attention at, was characteristic of a fewer part from vast set of publications on the history of technology.

Ideological ‘clouds’ in due course have disappeared, however problems in contacts with the international community for the Russian scholars have remained. One of them has traditionally been bad knowledge of English language. Besides, the decision of financial questions of trips abroad becomes almost unsolvable problem for the majority of scientists.

Slawomir LOTYSZ | University of Zielona Gora, Poland

After work hours: excursions, receptions, and social atmosphere

The main objective of the ICOHTEC’s annual meetings is to enhance scholarship by exchanging ideas, sharing expertise, and building interpersonal connections. The latter occurs mainly during excursions, receptions, and less formal meetings that take place when the sessions end.

The excursions bring conference attendees to sites of great interest, including general or topical museums of technology; sites of industrial heritage, such as factories and workshops (both abandoned and still in operation); and pieces of engineering art, such as bridges or dams. These sites not only have an obvious educational value, but also help to establish and sustain less formal connections between excursionists. The receptions and banquets, usually organized as elegant dinners, serve the same purpose. The social atmosphere warms from such events as jazz nights, group visits to the sauna, or spontaneously organized meet-ups with new or old friends. These relationships are often very fruitful and long-lasting, rendering the annual meeting unique and memorable.

Important components of this paper entail the presentation of images documenting the events that helped build the ICOHTEC community and the recollections of long-time committee members.

Susan SCHMIDT HORNING | St John’s University, United States

Swinging the Symposium: ICOHTEC’s Jazz Evenings and Other Musical Events

Most scholarly conferences include some time for relaxation and entertainment, but few can boast a regular jazz evening with musicians who are also society members. Since Hans-Joachim Braun organized the first configuration of what would become the *Email Special* in Budapest in 1996, these jazz evenings have become a regular feature of ICOHTEC meetings. It is fitting that music would find an ongoing presence in the annual ICOHTEC Symposia. As a scholarly society founded on international cooperation and interdisciplinary exchange of ideas, ICOHTEC’s mission has embraced openness and what better way to communicate across cultures than through the universal

language of music? It is also fitting that music would become an integral part of the events of a society rooted in European culture, since Europe was where American jazz musicians found more appreciative audiences than those in the United States during many decades of the twentieth century. But jazz has not been the only music enjoyed at our symposia.

This paper will trace the history of music at ICOHTEC conferences, from the German Dixieland band on the steamboat ride along the Elbe in 1987 to the first *Email Special* gig in Budapest a decade later and the subsequent re-configurations of the group over the years and across four continents, to the Bach organ recital of the late W. David Lewis in a church in Prague, to the blues power duo of Jeremy Kinney and Outi Ampuja. The story of how this musical tradition has evolved, how the local organizers have always managed to provide the necessary equipment—including a vibraphone!—is a study in international cooperation and attests to the collegial atmosphere of our society.

E118-B. From hardware to software: changes in the ICOHTEC research agenda

Mon 22 July, 14:10–15:40 ▪ Schuster Bragg

Session organisers:

Hans-Joachim BRAUN | Helmut Schmidt University, Hamburg, Germany

Stefan POSER | Helmut Schmidt University, Hamburg, Germany

Chair: Timo MYLLYNTAUS | University of Turku, Finland

R Angus BUCHANAN | University of Bath, United Kingdom

The theoretical and practical components of technological education

The experience of forty years of discussions in ICOHTEC has produced a mature understanding of the nature of technology. Crucial to this understanding has been the development of ideas about technological education, not as a sub-set of scientific education but as a distinctive procedure, requiring a combination of theoretical knowledge with practical skills, together with a comprehension of the global role of technology in stimulating innovation and securing its development. This subject was first tackled systematically by ICOHTEC in its 22nd Symposium, held in Bath in 1994, when a series of eighteen papers was presented on 'The institutional organisation of engineers' in which the educational culture of technology was explored in several dimensions. This in turn was one of five sections, in which the second, on 'The manufacture and marketing of gunpowder', also instituted what was to become a long-lasting group of scholars within ICOHTEC. Whereas the gunpowder group still survives, however, that on the educational culture of technology only ran for a few more symposia – at Liege, Lisbon, Belfort and Prague – before dispersing into a more general concern about the institutional and environmental consequences of modern technology.

Barton C. HACKER | Smithsonian Institution, United States

The ICOHTEC annual symposium on the social history of military technology

Since its inception in Leicester in 2006, the symposium on the social history of military technology organized by Bart Hacker assisted by Margaret Vining has become a regular and expanding feature of ICOHTEC's annual meeting. Academic and public interest in the history of military technology has always been substantial, but has usually been expressed in terms of weaponry, warships, fortifications, or other physical manifestations of warfare, with emphasis mainly on how they were made or how they worked, often in antiquarian detail. Historians have also tended to assume a strictly utilitarian and rational basis for military technological invention and innovation. However indispensable

such approaches may be, however valid such assumptions, they largely ignore some very important questions. What are the contexts of social values, attitudes, and interests, non-military as well as military, that shape and support (or oppose) these technologies? What are the consequences of gender, race, class, and other aspects of the social order for the nature and use of military technology? Or, more generally: How do social and cultural environments within the military itself or in the larger society affect military technological change? And the indispensable corollary: How does changing military technology affect other aspects of society and culture? In brief, how does military technology serve as both agent and object of social change? These and related questions have informed well over a hundred papers presented in past symposia. Selected papers from the first three symposia provided the basis for a special issue of ICOHTEC's journal, *ICON*. They have also inspired a new journal. In 2013 Brill, the Dutch publisher will launch *Vulcan: The Social History of Military Technology*. The first volume will include papers from the 2009 symposium in Budapest and the 2010 symposium in Tampere, as well as several outside contributions. Subsequent volumes will draw on later symposia, even as the pool of outside submissions expands.

James C. WILLIAMS | ICOHTEC / Stetson University, United States

Energy, technology and the environment

In the 1970s, an Arab oil embargo thrust energy forward as a topic concern in the United States and as well in Europe. In 1980, as part of a U.S. educational initiative focusing on energy, Mel Kranzberg joined two of his colleagues to edit *Energy and the Way We Live*, and soon thereafter a number of books dealing with the history of energy and technology emerged, among them George Daniels and Mark Rose's *Energy and Transport* (1982) and Thomas Hughes' *Networks of Power* (1993). At ICOHTEC's 1982 symposium in Smolenice, Czechoslovakia, participants agreed that the next symposium at Lerbach/Cologne, the Federal Republic of Germany, should focus on 'energy in history.' The 1984 Lerbach meeting resulted in two volumes of forty papers as well as a volume of Czechoslovakian contributions edited by Jarolave Purs. Through ICOHTEC's next five symposia, energy continued as a topic of interest with perhaps thirty papers looking at energy resources, production, transportation and urban use. Growing out of these energy topics, a closely related interest in the environment emerged, with my book, *Energy and the Making of Modern California* appearing in 1997 in a book series focusing on 'technology and the environment.'

Beginning in 1998 at the Lisbon symposium, technology and the environment appeared as a topic in its own right with a large session focusing on 'technology and natural disasters.' A year later in Belfort, France, an even larger session looked the 'natural environment and technological choice' and, with a second session on 'technological choice and society within the built environment,' melded energy consumption to the human/nature relationship. Several of the participants in these ICOHTEC sessions gathered at the Society for the History of Technology (SHOT) meeting in Munich in 2000, where in anticipation of ICOHTEC's Prague symposium on 'technological landscapes: energy, transport and environment,' they formed a new organization, Envirotech, which subsequently has met alternately with SHOT and the American Society for Environmental History. Thus, ICOHTEC's continued focus on technology, energy and the environment proved instrumental in giving birth to a new subfield in both the histories of technology and of the environment, one recently highlighted in the recent Envirotech sponsored book *The Illusory Boundary: Environment and Technology in History* (2010) and, as well, by publications of ICOHTEC members. This paper will briefly review ICOHTEC's role in the study of energy, technology and the environment as well as try to suggest directions for the future.

Stefan POSER | Helmut Schmidt University, Hamburg, Germany

Playing with technology

Research in the field 'Playing with Technology' ought to contribute to the development of theory in the history of technology: both technology and play have crucial functions in human life. They have strongly influenced the development of societies. Thus research in this field might open new perspectives on the question how and why people deal with technology. The key fields for research are sports, attractions of annual fairs and amusement parks, and technical toys. The approach is based on a broad comprehensive understanding of play.

Following Johan Huizinga, cultural developments are based on play. Although this view may be somewhat exaggerated, it is quite true that since the beginning of industrialization technology-based play has become increasingly important. Especially during the last decades it has gained considerable influence in developed societies: (i) the so-called leisure society have begun to take shape. Supply of and demand for games has increased; the leisure industry is still growing. (ii) Elements of play can be found in fields of work and applications of play in working processes (as in programming computers) are growing as well. (iii) Simulations and virtual worlds - which are close to play in some way - are becoming more important. This development became a reason for research in this field about ten or fifteen years ago.

Research in the playful approach to technology was developed far enough to organise an ICOHTEC session in the second half of the 2000s: 'Playing with Technology' has been an ICOHTEC subject since 2007 and discussion on an international level was and is helpful to extend and intensify research. The aim of the paper is to discuss different approaches which were presented to ICOHTEC and thus to analyse ICOHTEC's contribution to the young field of the history of technology.

E118-C. Long-term ICOHTEC research themes

Mon 22 July, 16:10–17:40 ▪ Schuster Bragg

Session organisers:

Hans-Joachim BRAUN | Helmut Schmidt University, Hamburg, Germany

Stefan POSER | Helmut Schmidt University, Hamburg, Germany

Chair: James C. WILLIAMS | ICOHTEC / Stetson University, United States

Hans-Joachim BRAUN | Helmut Schmidt University, Hamburg, Germany

All ears: ICOHTEC, music and sound

In 1968, when ICOHTEC was founded, there was little research on the topic of technology, music and sound, particularly in historical perspective. In the 1970s books like R. Murray Schafer's "The Tuning of the World" and Jacques Attali's "Noise. On the Political Economy of Music" shed some light on the topic, but it was not before the 1990s that a noticeable number of publications was published in this field. This came from various disciplines like musicology, science and technology studies, cultural and communication studies, film studies and ethnomusicology, but also, in a slowly increasing degree, from the history of technology. ICOHTEC has played a role in this which will be assessed in this paper. Starting with a large session at the ICOHTEC Symposium in Budapest in 1996, at which many scholars who are now established figures in the field gave papers, ICOHTEC's involvement in sound and music continued until the present day with major sessions in 2002, 2006 and 2011. Several publications resulted from this. ICOHTEC can claim to have provided an important forum for discussing the topic of music, sound and the history of technology. Its symposia have absorbed new trends in this field but they have also provided impulses and stimuli pointing towards new directions. Apart from a brief historical survey and

some stocktaking, the paper will try to identify new promising research areas like the relationship between seeing and hearing, training the ear, testing and simulation, or the relationship between sound and language (how to put sound and music into words?).

Reinhold BAUER | University of Stuttgart, Germany

Failed innovations: five decades of failure?

It was in 1959, that Howard Mumford Jones in a programmatic article on the history of technology demanded that the field should devote itself more intensively to the examination of failed innovations. The analysis of failure, he argued, was of special importance for the understanding of technical development and could pave the way towards a more comprehensive, more realistic description of technological change. Furthermore, if this change was analysed exclusively based on successful developments, a distorted picture of the historical process emerges: Technical development than seems to have followed a straight rational path hurrying along from success to success.

In the last five decades, Mumford's request was repeated with some regularity but unfortunately failure studies nevertheless kept playing a more or less minor role within the field for most of the time. It was only in the late 1980s, that a couple of scholars began to turn to the analysis of failed innovations, demonstrating the benefits an examination of "blots" can bring.

The paper is going to present the development of failure studies in the past decades, summarize their outcomes and last but not least discuss the role that ICOHTEC and the different ICOHTEC symposia played for the emergence and advancement of this field of research.

Brenda J BUCHANAN | University of Bath, United Kingdom

Gunpowder studies at ICOHTEC

The study of the history and technology of gunpowder, and its national and international significance in civil and military life, has been rescued from neglect by the sessions held over the years under the auspices of ICOHTEC. This is a bold claim but since our first meeting at the 22nd Symposium in Bath in 1994 much has been achieved: an informal fellowship of gunpowder historians has been established, two well-reviewed books have been published; individual scholars have had their work published by appropriate journals, and debates have been sparked that still continue, especially in the matter of saltpetre. None of this could have been achieved without the support of ICOHTEC. This began at the 1989 Symposium in Hamburg, with the helpful response to my request to be put in touch with anyone interested in this subject. The pursuit of these and other links, especially those with Chinese, Russian and French scholars made through meetings of the International Union, led to the building up the network of gunpowder historians who were to meet for the first time in 1994. Two years later **GUNPOWDER. THE HISTORY OF AN INTERNATIONAL TECHNOLOGY** (Bath University Press, 1996, reprinted 2006) was published, its twenty four chapters drawn from papers presented by authors from thirteen countries. Our second publication, **GUNPOWDER, EXPLOSIVES AND THE STATE. A TECHNOLOGICAL HISTORY** (Ashgate, 2006), shows the scope of more recent research, set in the context of seeing the securing of gunpowder supplies as fundamental to the power of the state and imperial pretensions.

The development of this subject over the years has demonstrated the strengths of ICOHTEC. These may be defined as: continuity, made evident by these 40th birthday celebrations; authenticity, as invitations which might otherwise be viewed with suspicion are accepted; inclusivity, a willingness to provide a home for new studies, especially those that may be unacceptable elsewhere; flexibility, as in the natural course of the life histories of informal bodies such as our gunpowder group, it now seems appropriate to meet within the newer Social History of Military Technology sessions, for which we thank its convenor; mobility, as our peripatetic society has met in fascinating places, enabling us to investigate significant gunpowder works such as those at

Barcarena near Lisbon; and sociability, as our symposia have over the years uplifted not only the mind but also the spirit.

Alexandre HERLEA | Université de Technologie de Belfort-Montbéliard, France, France

Science-technology relationships in historical perspective

Science - technology relationships has been a prominent topic in the history of technology from the very origin of this field and even before its birth. D'Alembert in the introduction to the "Encyclopédie" stated: "When you are reflecting on the links between the discoveries it is easy to realize that the sciences and the arts are supporting each other and consequently that there is a chain which unites them". Lucien Febvre in its manifest for the establishment of a new branch of history published in 1935 in "Les Annales" defined 3 main steps to get over: a technical (internal) history of technology, a history of science - technology relationships and the integration of these 2 approaches into a broad economic and socio-political history.

It is important to emphasize that the borders between science and technology are permeable and are not strictly reflecting the reality. Quite often the links between them are so strong that their separation is artificial. The distinction between science and technology are mainly based on various aims, the technology has in view efficiency and ability and science has in view knowledge.

In ICOHTEC, the international society of the History of Technology, the topic of science - technology relationships has, naturally, had a privileged place. It has been present from the beginning (1968) in mainly all ICOHTEC symposia at different levels, disregarding the main theme. And it is normal because many themes in the history of technology have a science - technology relationships dimension. Three symposia were specifically consecrated to this theme: the meeting in Dresden 1986, which was devoted to the relations between technology and the engineering sciences; the large ICOHTEC symposium on "Science-Technology Relationships" in Paris 1990, which has broadened the debate in all its various aspects (publication edited by Alexandre Herlea, San Francisco Press 1993) and the extensive session on "Materials: Research, Development and Applications", Liege 1997, which deals with science - technology relationships in the field of materials (publication ed. by Hans-Joachim Braun and Alexandre Herlea, Turnhout, Brepols 2002).

What contributions did ICOHTEC make to the discussion? How did the topic develop and what is the present state? What about applied science, experimental science, engineering science, science-based technology and technology-based science, what about technology developing independent from science? What about "research technologies", the "triple helix" debate and the "Stanford-Yale-Sussex Synthesis"? What about current research topics like biotechnology or nanotechnology and what about future research perspectives? These are the questions to which I will try to answer in my paper.

E300. Neu-Whitrow Bibliography Prize presentation and Commission on Bibliography and Documentation business meeting

Sponsoring body:

DHST Bibliography and Documentation Commission

Fri 26 July, 16:00–17:30 • Uni Place 3.204

Special session organiser: **Birute RAILIENE** | Wroblewski Library of the Lithuanian Academy of Sciences, Lithuania

A hundred years ago the famous historian George Sarton (1884-1956), a founder of the discipline of history of science, started the Isis Bibliography of History of Science. After Sarton, two bibliographers, John Neu at the University of Wisconsin, and Magda Whitrow at Imperial College, London, carried on Sarton's legacy.

The Commission on Bibliography and Documentation (CBD) of the IUHPS/DHST has established a Withrow-Neu Bibliography Prize, to be awarded for the first time in 2013 for the best bibliography or manuscript finding aid in the history of science for the period 2009-2013. This prize recognizes the efforts of those two bibliographers for the work they did to support history of science scholarship around the world.

This special session will begin with a talk by Stephen Weldon on the history of history of science bibliography, which will include an introduction to the life and work of John Neu. Frank James will then talk about Magda Whitrow. Gavan McCarthy and Silvia Waisse will introduce the Whithrow-Neu Bibliography Prize competition and the award will be made to the winner, Dr Jennifer Rampling, who will be asked to say a word.

Following the award, the CBD will hold a short business meeting.

Chair: **Birute RAILIENE** | Wroblewski Library of the Lithuanian Academy of Sciences, Lithuania

With contributions from:

Stephen WELDON | University of Oklahoma, United States

Frank JAMES | Royal Institution, United Kingdom

Gavan MCCARTHY | University of Melbourne, Australia

Silvia WAISSE | Pontificia Universidade Católica de São Paulo, Brazil

Jennifer RAMPLING | University of Cambridge, United Kingdom

E301. The future of journals in the history of science, technology, and medicine

Tue 23 July, 14:10–15:40 • Uni Place 4.214

Special session organiser: **Robert Fox** | University of Oxford, United Kingdom

Journals in the history of science, technology and medicine face unprecedented challenges. The growth of online publication (with its consequences for traditional, hard-copy editions) and the pressure for open access to all publicly funded research are among the most obvious recent developments that have forced editors, publishers, librarians, and the users of journal literature to rethink their practices. The threats and opportunities that these new departures present have highlighted the need for the interested parties to share ideas and experiences. This special discussion session responds to that need.

The session will begin with three or four brief statements by a panel representing the various interests and thereafter reserve as much time as possible for the exchange of opinions and proposals for action. As convener, Robert Fox (robert.fox@history.ox.ac.uk) would welcome suggestions for topics for inclusion in what is likely to be a full agenda.

With regard to Open Access (OA), such topics will certainly include the rival merits of 'gold' and 'green' access and the implications of OA for the publishing strategies of researchers, especially those at an early stage in

their careers, and for the viability of even well-established journals in our field. On a quite different front, we may wish to reflect on the growing dominance of English as the language of communication for our work. What are the consequences for scholars working and wishing to publish in languages other than English?

E302. Discussion: social media, public engagement and the history of science, technology and medicine

Mon 22 July, 16:00–17:40 • Uni Place 1.219

Special session organiser: **Rebekah HIGGITT** | Royal Museums Greenwich, United Kingdom

Fittingly, this session will use a social media platform to bring together, online, a panel of individuals at two conferences and in two countries, in order to discuss the issues raised by engaging with different audiences through social media. It is a panel that sits within the programmes of both the Manchester-based International Congress and the [8th Annual Science in Public Conference](#), being held at the University of Nottingham. The panel consists of speakers with experience of using social media and engaging with other groups and the wider public in a range of personal and professional contexts.

The session will include several short presentations before opening out to wider discussion. The focus will be on individuals' experiences of using social media to reach out to wider, or other, audiences on the history of science, technology and medicine, and related topics. It will introduce the audience to some of the different forms and uses of social media and focus on how it can bridge or divide online communities. The speakers will probe the categories of academia, social media and the public, and discuss the importance of listening and two-way communication rather than simply broadcasting.

It is notable that social media has played an important role in developing links between the history of science and other fields in the humanities and social sciences. However, online communities can also encourage tribalism and lead to clashes with other groups. The session will explore whether such clashes can be productive, or if there greater danger of closing down communication and defining opposing sides. Participants will reflect on the ways in which online context may change what we choose to say, and how, and what we can learn from those who have interacted with groups that have very different agendas.

The session will give some historical context to the role of public engagement, and future uses of social media in engaging the public with science and its history. It is clear that social media blurs the lines between expert and lay, colleagues and public, subjects and audiences, and that this can be hugely rewarding and productive, but also provocative and troubling.

This session will be followed by an informal [tweetup](#) at the Ducie Arms pub.

With contributions from:

Rebekah HIGGITT | Royal Museums Greenwich, United Kingdom

Vanessa HEGGIE | University of Birmingham, United Kingdom

Alice Bell, University of Sussex (online from Science in Public 2013)

Gregory HOLLIN | University of Nottingham, United Kingdom

Lucy Veale, University of Nottingham (online from Science in Public 2013)

Nathaniel C Comfort, Johns Hopkins University (online)

Darin Hayton, Haverford College (online)

Why blog? An introduction

Event code: **F303**

Mon 22 July, 13:00–13:45 • Uni Place 4.205

Organisers:

Rebekah HIGGITT | Royal Museums Greenwich, United Kingdom

Vanessa HEGGIE | University of Birmingham, United Kingdom

In this session, Rebekah Higgitt and Vanessa Heggie, who run [The H Word](#) for the Guardian Science Blogs network, will discuss the whys and hows of blogging and other forms of social media for communicating research and HSTM. This session will involve brief talks, discussion and demonstration.

Attendees are welcome to email or tweet questions, or examples of good (or bad) practice before the session: see links above for contact details. The conveners will try to get through as many as possible!

E306. Screening: Ernest Rutherford documentary

Sponsoring body:

Manchester Literary and Philosophical Society

Fri 26 July, 16:00–17:30 • Schuster Blackett

Special session organiser: **John CAMPBELL** | Rutherford Documentary, New Zealand

Amazingly, until now, there has never been a documentary on Ernest Rutherford, New Zealand's internationally most famous son, the first Nobel Prize recipient for research performed in Canada, and probably the most illustrious British scientist of the first half of the twentieth century. *The Rutherford Documentary* has been produced by John Campbell, based on his book, *Rutherford: Scientist Supreme*. Recorded in high-definition digital video, it consists of three one-hour episodes, for which the Canadian Nuclear Society awarded John an Education and Communication Award.

This special session will be introduced by John Campbell himself. John will talk about the making of the documentary before screening Episode 2, 'The Alchemist', which covers Rutherford's life and work in Canada and at Manchester. At McGill University, Rutherford transmitted the first wireless signals between a station and a moving train, explained radioactivity as the natural transmutation of atoms, discovered radon, dated the age of the earth, and earned himself a Nobel Prize. At Manchester, he developed the Rutherford-Geiger tube, showed that the atom had a nuclear structure, and became the first person to split the atom, or put another way, became the world's first successful alchemist. During the First World War, he directed the scientific work associated with detecting submerged submarines.

John will be happy to answer any questions. He is the author of *Rutherford: Scientist Supreme* (1999) and maintains the website www.rutherford.org.nz. He initiated and runs the Ask-A-Scientist programme, which has seen some 100,000 column-centimetres of science in New Zealand newspapers. He has several awards for communicating science to the public and has organised some 50

firewalks throughout New Zealand, plus three in the USA, which probably makes him certifiable.

E307. Screening: John Milne documentary

Wed 24 July, 11:00–12:30 • Uni Place 1.218

Special session organiser: **William TWYXCROSS** | Independent scholar, Australia

In a world where population is increasingly huddled around coastlines, with ever larger cities, earthquakes and tsunamis have become increasingly dangerous to human populations. *The Man Who Mapped The Shaking Earth* documents one of the world's great scientific quests in a fascinating ride through Newfoundland, Iceland, England, the Sinai, Russia, China, Japan, and New Zealand.

John Milne was born in Rochdale, near Manchester, in 1850. At the age of 25, he worked as the first Professor of Geology at Tokyo University in the Japan of the Emperor Meiji (1875-1895). In Japan, he invented the modern seismograph, pioneered earthquake resistant building techniques and created the first instrument-based maps of seismicity. Milne also founded the world's first seismological society and journal. On his return to England, he established the first worldwide network of seismographs.

The Man Who Mapped The Shaking Earth was filmed in 2011, in a 28-day journey through eight countries, and is being released to coincide with the one hundredth anniversary of Milne's death (31 July 1913). The film-maker, Dr Will Twycross, is John Milne's great-nephew. He won the Victorian Community History award for Multimedia in 2010, and has shot the documentary in High Definition, with a sound track featuring an original musical score.

After the screening, Dr Twycross will join a panel of fellow authorities to answer questions about the life of John Milne.

With contributions from:

William TWYXCROSS | Independent scholar, Australia

Patrick NOTT | Retired, United Kingdom

Paul KABRNA | Craven and Pendle Geological Society, United Kingdom

E308. Victorian science spectacular

Tue 23 July, 11:00–12:30 • Pear Lecture Theatre, Coupland 1 Building

Roll up, roll up! What futuristic marvels amused the Victorians and Edwardians? A band of time-travelling professors present the cutting edge of science and technology from over a century ago. Be amazed and diverted by our phonograph, magic lantern, 'animated photographs', and chemical and electrical experiments from the 1800s. How have attitudes to innovation and the future changed since then? And how far has the Victorian blend of education with entertainment stayed with us?

Funded by a 'Care for the Future' grant from the Arts and Humanities Research Council.

There will also be a public performance at the Portico Library on Tuesday evening: please see event L342 on the public programme.

With contributions from:

Aileen FYFE | University of St Andrews, United Kingdom

Iwan Rhys MORUS | Aberystwyth University, United Kingdom

Katy PRICE | Queen Mary, University of London, United Kingdom

Tim Cockerill

E309. Manchester in the history of science, technology and medicine

Tue 23 July, 14:10–17:40 • Uni Place 4.205

Special session organiser: **John PICKSTONE** | University of Manchester, United Kingdom

As a city of science and industry, Manchester is iconic. Its contributions to the physical sciences stretch from John Dalton and James Joule, through Ernest Rutherford, Lawrence Bragg and Patrick Blackett, to the recent Nobel Prize for graphene. Its engineers range from Richard Roberts, William Fairbairn, James Nasmyth and Joseph Whitworth to Osborne Reynolds, Horace Lamb and the creators of the Manchester computer in 1948. Its wider stories encompass such figures as WS Jevons, Alan Turing and Michael Polanyi; a century and more of notable organic chemists; contributions to medical ethics, public health issues and prostheses; suffrage and birth control; and classic debates about industrialisation, energy and science policy.

In this pair of sessions, we will examine the Manchester legacy, its uses, and the wider context of urban/civic cultures of science, technology and medicine.

Session A will begin with brief presentations on how local researchers are using Manchester's heritage to engage with both public and policy audiences. We will address cases including Rutherford's laboratory; the Computer Laboratory where Turing worked; the Schunck Building, once the laboratory and library of a noted industrial chemist; current work on the recent history of the University Medical School; and an outline of the emerging University of Manchester Heritage Programme. Afterwards, there will be time for general discussion on how historians of science, technology and medicine can best use their local heritage resources. This session should appeal to historians of Manchester, and of universities, and to all who are interested in public history.

Session B consists of a roundtable discussion on the history of science, technology and medicine in Manchester and similar cities. We aim to bring together Congress attendees with serious interests in Manchester STM and in wider topics such as industrialisation, city cultures, urban renewal and civic universities. We will also invite historians of Manchester and its region who would not normally attend the Congress, but whose knowledge and perspectives may be useful.

The sessions offer an opportunity to make contacts, discuss research projects, compare notes and plan joint ventures: there is no fixed agenda, except to make connections and stimulate discussions. If you wish to make suggestions before the Congress, you are welcome to contact the convenor, John Pickstone:

john.pickstone@manchester.ac.uk

Please note also the tours of the historic campus, running daily at lunchtimes and late afternoons in conjunction with this session. All will last around 45 minutes, with plenty of time for discussion. For more details, see the [walks and tours page](#) or ask at the Congress Events Desk.

E310. The tables turned: Victorian séance event

Sponsoring body:

BSHS Outreach and Education Committee

Fri 26 July, 14:00–15:30 ▪ Pear Lecture Theatre, Coupland 1 Building

Special session organiser: **Sabine CLARKE** | University of York, United Kingdom

The Tables Turned is a public event that was developed by members of the British Society for the History of Science for audiences of young people. It has been performed several times over the last five years. The key aim is to explore the question 'How are facts made in science?' using a Victorian séance as its vehicle.

The Tables Turned uses role play in which performers in costume assume a number of roles, and the audience are encouraged to participate as members of the Manchester Literary and Philosophical Society. A meeting of the Society has been convened in 1860 to hear evidence by two eminent scientists, a poet and a journalist on their experiences of attending a séance. The audience are asked to consider evidence on the truth of such phenomena as table turning, the question of whether scientists should be called upon to judge such events and the reasons why little consensus emerged about the truth of spiritualism in the nineteenth century.

Come along to see a staging of the event, join in the role-play exercise and participate in discussion about exploring potentially difficult epistemological issues with non-specialist audiences.

There will also be a public performance at the Portico Library on Friday evening: please see event L344 on the public programme.

Graduate students' guide to Manchester

Event code: **F311**

Mon 22 July, 13:00–13:45 ▪ Uni Place 4.204

Graduate students from the University of Manchester's [Centre for the History of Science, Technology and Medicine](#) share their favourite things to see, hear, drink and eat in and around Manchester. There will be a particular focus on places handy for iCHSTM venues and accommodation. Further information is also available on the [CHSTM PhD Blog](#).

Graduate students' guide to Manchester

Event code: **F312**

Tue 23 July, 13:00–13:45 ▪ Uni Place 4.204

Graduate students from the University of Manchester's [Centre for the History of Science, Technology and Medicine](#) share their favourite things to see, hear, drink and eat in and around Manchester. There will be a particular focus on places handy for iCHSTM venues and accommodation. Further information is also available on the [CHSTM PhD Blog](#).

Publishers' advice session: thesis to book (Manchester University Press)

Event code: **F315**

Wed 24 July, 13:00–13:45 ▪ Uni Place 4.206

In this session, experts from Manchester University Press will explore how to reformulate your thesis/dissertation for book publication.

Metrics and journal rankings: a workshop

Event code: **F316**

Thu 25 July, 13:00–13:45 ▪ Uni Place 4.204

In this workshop, Chris Tancock, publisher for Elsevier's history and science portfolio, will explore why and how journal and research quality is measured. We will consider the origins, features and drawbacks of the Impact Factor as well as looking at the H-Index, SCImago Journal Rank and other metrics. This will be an open and informative session, aimed at those who are interested in the metrics associated with academic publishing, how they work and how they can affect a researcher's career.

Careers and funding: academia, museums, and public institutions

Event code: **F317**

Tue 23 July, 13:00–13:45 ▪ Uni Place 4.205

Part of a series of lunchtime sessions aiming to give practical advice on how to find jobs, get jobs, apply for research funding, and match your skills and interests to short- and long-term career possibilities – both in academia and in a variety of related activities. Each session opens with short talks from a small panel of experts on their own experience and the general state of the field. The panellists will then take questions from the audience, with the opportunity for general discussion.

This session will compare job prospects, funding mechanisms and working conditions across higher education, traditional museums and public engagement institutions, and other organisations with a role for historical research or teaching.

The session is aimed particularly at graduate students, early career researchers, and those seeking to enter the field for the first time, but all are welcome to attend.

With contributions from:

Sabine CLARKE | University of York, United Kingdom

Charlotte CONNELLY | Science Museum, London, United Kingdom

Frank JAMES | Royal Institution, United Kingdom

Careers and funding: public engagement in the history of

science, technology and medicine

Event code: **F318**

Wed 24 July, 13:00–13:45 ▪ Uni Place 4.205

Part of a series of lunchtime sessions aiming to give practical advice on how to find jobs, get jobs, apply for research funding, and match your skills and interests to short- and long-term career possibilities – both in academia and in a variety of related activities. Each session opens with short talks from a small panel of experts on their own experience and the general state of the field. The panellists will then take questions from the audience, with the opportunity for general discussion.

This session is inspired by the growing focus on engagement with non-specialist audiences which has been heavily promoted by various funding bodies in recent years: this has led both to more public-engagement projects conducted by traditional research academics, and to greater collaboration between universities, museums, and other public-focused bodies. The panel includes researchers who are currently leading projects aimed at public audiences in a range of institutional contexts.

The session is aimed particularly at graduate students, early career researchers, and those seeking to enter the field for the first time, but all are welcome to attend.

With contributions from:

Anna ADAMEK | Canada Science and Technology Museum, Canada

Aileen FYFE | University of St Andrews, United Kingdom

Tim BOON | Science Museum, London, United Kingdom

Careers and funding: policy advisors and history

Event code: **F319**

Thu 25 July, 13:00–13:45 ▪ Uni Place 4.205

Part of a series of lunchtime sessions aiming to give practical advice on how to find jobs, get jobs, apply for research funding, and match your skills and interests to short- and long-term career possibilities – both in academia and in a variety of related activities. Each session opens with short talks from a small panel of experts on their own experience and the general state of the field. The panellists will then take questions from the audience, with the opportunity for general discussion.

This session is inspired by the growing focus on engagement with non-specialist audiences which has been heavily promoted by various funding bodies in recent years: this has led both to more public-engagement projects conducted by traditional research academics, and to greater collaboration between universities, museums, and other public-focused bodies. The panel includes researchers who are currently leading projects aimed at public audiences in a range of institutional contexts.

The session is aimed particularly at graduate students, early career researchers, and those seeking to enter the field for the first time, but all are welcome to attend.

With contributions from:

Melissa Smith, UK civil service, Department of Energy and Climate Change

Fern ELSDON-BAKER | Coventry University, United Kingdom

E336. Screening: *A City Speaks*

Wed 24 July, 18:00–19:30 ▪ Schuster Bragg

First screened in 1947, *A City Speaks* is an iconic documentary film, made for the Manchester Corporation and directed by the celebrated film-maker and historian Paul Rotha. An introductory sequence, showing the commerce and industry of Manchester, is followed by a historical account of the city's development from Roman times through the Industrial Revolution, social reform, and public services, as the authorities of the city – and all cities – faced the uncertainties and opportunities of the post-Second World War world.

This session will include a full screening of the 64-minute film, with a brief introduction from Dr Tim Boon and closing discussion from Dr Charlotte Wildman, and there will also be time for audience questions and discussion.

With contributions from:

Tim BOON | Science Museum, London, United Kingdom

Charlotte WILDMAN | University of Manchester, United Kingdom

E337. Nineteenth-century geological sections (lunchtime viewing session)

Sponsoring bodies:

HOGG: History of Geology Group

Fri 26 July, 13:00–13:30 ▪ Uni Place 1.219

For the benefit of Congress delegates who are not attending [symposium S113 on geological fieldwork](#), we have arranged a special lunchtime viewing of the two large geological sections, dating from the early nineteenth century, which will be presented during the symposium.

The first section was drawn and coloured by Thomas Sopwith in 1839, though it is unfinished. It shows the detail of the strata of a 45km (28 mile) stretch west-to-east across northern England, and is itself almost 13m (42 feet) long. Sopwith was a mining engineer, and his goal was to map the strata around the lead mines of the district. This object is the property of Graham Carlisle, and is thought not to have displayed since the nineteenth century, surviving in its canister in a remarkable state of preservation. S113-B will feature a paper by Susan Turner about this section.

The second section dates from 1815, and is an original manuscript version of a section by David Mushet. It shows a cross-section of the strata of part of the Forest of Dean, in south-west England and is 3½m (11 feet) long. Mushet was a metallurgist who worked mainly in the iron-smelting industry, and his main geological interest in the Forest of Dean was to map coal mines – one of the mines he invested in is featured on the section. In 1815 he presented a copy of the section to the Geological Society of London, and it seems his work also influenced Thomas Sopwith's surveys of the Forest of Dean in the 1830s. This object is owned by Cherry Lewis, who will be attending S113.

Please note that, to protect the artefacts, no food or drink is permitted in the room.

With contributions from:

Cherry LEWIS | University of Bristol, United Kingdom

Graham CARLISLE | Independent scholar, United Kingdom

E343. Of music, engineers and drugs: when Cottonopolis became Madchester

Wed 24 July, 16:00–17:30 • Uni Place 1.218

This special session aims to explore the social and cultural changes that took place in Manchester and Britain during the 1980s and in particular the rise of the popular music scene recently portrayed in films including *24 Hour Party People* and *Control*. Thanks to new bands (Joy Division/New Order, Smiths, Happy Mondays, amongst others) and the establishment of the Hacienda nightclub, Manchester came to occupy an important place in the international musical arena of the 1980s and 1990s at a time when the city's social landscape was also changing considerably. 'Cottonopolis', the traditional birthplace of the Industrial Revolution, was about to become 'Madchester'.

While this was about to happen, an invisible link seem to unite old and new, as social changes through the rise and availability of new technologies informed the music experience. And if many historians in the past have focussed on the technological determinants of the Industrial Revolution in Manchester and elsewhere, we know far less about more recent transformations.

Somewhat unconventionally and experimentally, this session aims to explore these themes by moving away from Manchester's warehouses and into the places where music was produced and consumed (recording studios, concert halls and clubs). We thus aim to reflect on two overlapping issues: firstly, how technological innovation in music-making was influential in shaping some of these changes and, secondly, how the music experience was informed by the availability of new recreational drugs.

Confirmed speakers:

Dave Haslam, Hacienda DJ and author of *Manchester, England*

Susan Schmidt Horning, History, St. John's College, New York, author of *Chasing Sound* and contributor to H. J. Braun, ed., of *Music and Technology in the Twentieth Century*

Peter Hook, Joy Division/New Order, author of *Hacienda: How not to run a club*

James Mills, Centre for the Social History of Health and Healthcare Glasgow (CSHHH), University of Strathclyde, author of *Cannabis Britannica: a social and political history of cannabis and British government, 1800-1928*.

With contributions from:

Dave Haslam

Susan SCHMIDT HORNING | St John's University, United States

Peter Hook

James Mills

Women and Gender Studies Commission business meeting

Event code: **C251**

Sponsoring body:

DHST Commission on Women and Gender Studies
Fri 26 July, 09:00–10:30 • Uni Place 3.204

Modern Chemistry Commission business meeting

Event code: **C252**

Sponsoring body:

DHST Commission on the History of Modern
Chemistry
Sat 27 July, 11:10–12:40 • Uni Place 4.214

Scientific Instrument Commission business meeting

Event code: **C253**

Sponsoring body:

SIC: DHST Scientific Instrument Commission
Wed 24 July, 09:00–10:30 • Schuster Rutherford

Meteorology Commission business meeting

Event code: **C254**

Sponsoring body:

DHST International Commission on the History of
Meteorology
Fri 26 July, 12:45–13:45 • Uni Place 1.218

CHAMA business meeting

Event code: **C255**

Sponsoring body:

CHAMA: DHST Commission for the History of
Ancient and Medieval Astronomy
Fri 26 July, 09:10–12:40 • Roscoe 2.5

INHIGEO business meeting

Event code: **C256**

Sponsoring body:

INHIGEO: International Commission on the History of
the Geological Sciences (International Union of
Geological Sciences and DHST)
Sat 27 July, 14:10–17:40 • Roscoe 2.3

History of Geography IUC business meeting

Event code: **C257**

Sponsoring body:

History of Geography Inter-Union Commission
(International Geographical Union and DHST)
Fri 26 July, 09:10–10:40 • Uni Place 4.214

CHOSTIS business meeting

Event code: **C258**

Sponsoring body:

CHOSTIS: DHST Commission on History of Science
and Technology in Islamic Societies
Fri 26 July, 16:00–17:30 • Uni Place 2.218

Oceanography Commission business meeting

Event code: **C260**

Sponsoring body:

DHST Oceanography Commission
Tue 23 July, 09:10–10:40 • Uni Place 4.214

ICOHTEC Executive Committee meeting

Event code: **C261**

Sponsoring body:

ICOHTEC: International Committee for the History of
Technology
Tue 23 July, 14:10–17:40 • Schuster Bragg

History of Mathematics IUC business meeting

Event code: **C262**

COMMITTEE MEETINGS

Sponsoring body:

ICHM: International Commission on the History of Mathematics (International Mathematical Union and DHST)

Fri 26 July, 16:10–17:40 • Uni Place 2.219

Pacific Circle Commission business meeting

Event code: **C263**

Sponsoring body:

DHST Pacific Circle Commission

Fri 26 July, 11:10–12:40 • Uni Place 4.214

Modern Physics Commission business meeting

Event code: **C264**

Sponsoring body:

DHST Commission for the History of Modern Physics

Tue 23 July, 12:45–13:45 • Roscoe 2.5

IASCUD Executive Committee meeting 1

Event code: **C265**

Sponsoring body:

IASCUD: International Association for Science and Cultural Diversity

Tue 23 July, 14:00–15:30 • Room 2.57, Simon Building

East Asia Commission business meeting

Event code: **C266**

Sponsoring body:

DHST East Asia Commission

Fri 26 July, 17:45–19:00 • Room 2.57, Simon Building

ICOHTEC General Assembly

Event code: **C267**

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Fri 26 July, 16:00–17:30 • Schuster Rutherford

Science and Empire Commission business meeting

Event code: **C268**

Sponsoring body:

DHST Science and Empire Commission

Mon 22 July, 11:00–13:00 • Uni Place 4.212

History of Astronomy IUC business meeting

Event code: **C269**

Sponsoring body:

History of Astronomy Inter-Union Commission

Fri 26 July, 15:00–15:30 • Uni Place 4.212

DHST Council Meeting

Event code: **C271**

Sponsoring body:

Division of History of Science and Technology (DHST) of the International Union of History and Philosophy of Science

Sun 21 July, 15:00–17:30 • Room 2.57, Simon Building

DHST General Assembly 1

Event code: **C272**

Sponsoring body:

Division of History of Science and Technology (DHST) of the International Union of History and Philosophy of Science

Wed 24 July, 14:00–17:30 • Uni Place LT A and B

The General Assembly is the highest administrative authority of the [Division of History of Science and Technology](#). It normally meets every four years, on the occasion of an International Congress of History of Science and Technology.

The General Assembly consists of the National Members, the elected representatives of the Commissions, Scientific Sections, Inter-Union Commissions, DHST-DLMPS Joint Commission, and the members of the Council. A quorum requires at least half the total number of National Members to be present. It is customary to invite the Secretary General or President of the DLMPS to attend the General Assembly as well as representatives from other associated bodies.

This session will consider the following business:

1. Approval of the agenda
2. Approval of the voting list
3. Report of the Secretary General
4. Report of the Treasurer
5. Nomination of examiners for the accounts
6. Proposal and vote for the new DHST Vade Mecum.
7. Presentation of candidatures for next DHST Council

DHST General Assembly 2

Event code: **C273**

Sponsoring body:

Division of History of Science and Technology (DHST) of the International Union of History and Philosophy of Science

Sat 27 July, 14:00–17:30 • Uni Place LT A and B

The General Assembly is the highest administrative authority of the [Division of History of Science and Technology](#). It normally meets every four years, on the occasion of an International Congress of History of Science and Technology.

The General Assembly consists of the National Members, the elected representatives of the Commissions, Scientific Sections, Inter-Union Commissions, DHST-DLMPS Joint Commission, and the members of the Council. A quorum requires at least half the total number of National Members to be present. It is customary to invite the Secretary General or President of the DLMPS to attend the General Assembly as well as representatives from other associated bodies.

This session will consider the following business:

1. Nomination of examiners for the DHST Council elections
2. Report of financial examiners
3. Proposals for hosting next (25th) IUHPS/DHST Congress and vote
4. Approval of the nominations of the Presidents of the Commissions
5. Proposals for new commissions
6. Other matters (presented by G.A. members)
7. Approval of the Manchester Manifesto
8. Election of the new DHST Council

IAHS General Assembly

Event code: **C274**

Thu 25 July, 15:45–17:45 • Schuster Rutherford

BSHS EGM

Event code: **C275**

Sponsoring body:

British Society for the History of Science

Fri 26 July, 12:45–13:45 • Schuster Blackett

Tyndall Correspondence Project meeting

Event code: **C276**

Tue 23 July, 12:45–13:45 • Uni Place 3.205

IASCUD General Assembly

Event code: **C281**

Sponsoring body:

IASCUD: International Association for Science and Cultural Diversity

Tue 23 July, 16:10–17:40 • Uni Place 4.214

IASCUD Executive Committee meeting 2

Event code: **C282**

Sponsoring body:

IASCUD: International Association for Science and Cultural Diversity

Fri 26 July, 16:10–17:40 • Uni Place 4.212

Teaching Commission business meeting

Event code: **C283**

Sponsoring body:

DHST Teaching Commission

Thu 25 July, 12:45–13:45 • Uni Place 3.205

DHST Council meeting 2 (incoming and outgoing Council)

Event code: **C284**

Sponsoring body:

Division of History of Science and Technology (DHST) of the International Union of History and Philosophy of Science

Sun 28 July, 08:30–09:30 • Room 2.57, Simon Building

Welcome reception

Event code: **J321**

Sun 21 July, 18:00–20:00 ▪ Manchester Museum

The iCHSTM 2013 Welcome Reception will be held at the Manchester Museum, a minute's walk across Oxford Road from the main Congress venue.

The Manchester Museum is the largest university museum in the UK, with collections of around 4.5 million items focusing on natural history (zoology, botany, geology) and ethnography. It opened to the public in 1888 and forms an integral part of the University of Manchester's oldest core of buildings, occupying most of the impressive neo-Gothic frontage along Oxford Road.

Our reception will be held across two galleries, both occupying parts of the original site. The **Fossils gallery** presents a journey through the emergence of life, from the 3500-million-year-old Ediacara biota of Australia to the early human occupation of Britain. The centre of attention for most visitors is 'Stan', an unusually complete *Tyrannosaurus rex* cast from a fossil excavated in South Dakota in 1992, but the displays also represent the Museum's historic strength in plant palaeontology – a major consideration in a city and region driven by coal.

Upstairs, the **Living Worlds gallery** reveals something of the historical evolution of the Museum itself. Previously home to a very traditional taxidermic display of mammal specimens, the gallery was comprehensively remade in 2011 with a brief to explore the connections between all living things, including human societies. The carefully preserved nineteenth-century fabric, including original display cases, contrasts interestingly with the new presentation, developed with the Belgian art and fashion show producer Villa Eugénie and addressing themes such as 'Resources', 'Bodies', 'Variety of life' and 'Domination'.

Drinks will be provided at this event.

For current activities at the Manchester Museum, see the website: www.museum.manchester.ac.uk

For the history of the Manchester Museum, start with Samuel J M M Alberti, *Nature and Culture: Objects, Disciplines and the Manchester Museum*, Manchester University Press, 2009.

UK learned societies' reception

Event code: **J322**

Sponsoring bodies:

British Society for the History of Science

Newcomen: the International Society for the History of Engineering and Technology

Society for the History of Alchemy and Chemistry

HOGG: History of Geology Group

Royal Society of Chemistry Historical Group

Society for the Social History of Medicine

Institute of Physics History of Physics Group

Society for the History of Natural History

Mon 22 July, 18:00–19:30 ▪ Uni Place Drum

Although the British Society for the History of Science is the adhering body to the Division of the History of Science of the International Union for the History and Philosophy of Science, it works in close collaboration

with many other learned societies in Britain. Many of these have come together to sponsor the UK Learned Societies' Reception on the first full day of the Congress to welcome everyone attending this Manchester meeting.

The reception will be held on the ground floor of University Place, the main Congress venue. Drinks will be provided, and all delegates are welcome to attend.

Civic reception

Event code: **J323**

Tue 23 July, 19:00–21:00 ▪ Manchester Town Hall

The Civic Reception will be held at Manchester Town Hall, and will be attended by the Lord Mayor of Manchester.

Completed in 1877, Manchester Town Hall is a fine example of the Victorian Gothic style adopted for many of the civic showpiece buildings of the industrial north. Designed by Alfred Waterhouse, also responsible for the University of Manchester's Oxford Road frontage, the layout makes ingenious use of an unpromising triangular plot to achieve a grand frontage and impressive vaulted interiors.

The main reception venue is the **Great Hall**, home to the famous sequence of twelve murals to which the pre-Raphaelite artist Ford Madox Brown devoted the last six years of his life. The murals depict a somewhat legendary version of the history of Manchester which strongly emphasises science and technology, with depictions of the astronomer William Crabtree observing the transit of Venus, John Kay, inventor of the flying shuttle, and the atomic theorist John Dalton collecting marsh gas. Dalton also appears in statue form at the Town Hall's main entrance: facing him across the entranceway is his pupil, James Prescott Joule of Salford, pioneer of thermodynamics.

The reception also has use of the **Lord Mayor's Parlour**, a lofty room hung with portraits of public figures and paintings presented to the city; and the foyer outside the Great Hall, known as '**The Bees**' on account of the bee motif on its mosaic floor. As a highly organised creature which makes a useful product, the bee appealed as a symbol to the industrial interests of Manchester, and appears in the city's coat of arms.

Drinks will be provided at this event.

To find out more about Manchester Town Hall, visit the website: www.manchester.gov.uk/townhall/

Museum of Science and Industry reception

Event code: **J324**

Sponsoring bodies:

Society for the History of Technology (SHOT)

Science Museum Group

Thu 25 July, 19:00–21:00 ▪ Museum of Science and Industry

The Museum of Science and Industry (MOSI) occupies the site of the former Liverpool Road Station. It was here, in 1830, that the first-ever passenger rail line opened, connecting Manchester to Liverpool and the coast. Although the site was converted to goods-only use within a few years, the station exterior and departure platforms were preserved, making Liverpool Road the oldest surviving rail station in the world. Around this nucleus grew a large complex of goods warehouses and transit sheds, most of which were converted for Museum use in the

1980s. Today, MOSI is home to a huge range of collections from the region's scientific and technological history, and takes it as its mission to explore 'how science, industry and innovation created the world we live in today'.

The reception will take place across three of MOSI's most popular galleries:

Revolution Manchester, the introductory gallery, showcases iconic artefacts representing the contributions of the city and region to aviation, textiles, precision engineering, energy production, microscopy and computing. Highlights include a complete working replica of the 'Manchester Baby' prototype computer, the first machine to demonstrate the stored-program concept, built at the University of Manchester in 1948.

The **Power Hall**, a former goods shed, houses one of the world's largest collections of working steam engines, from train locomotives to the stationary plants which powered the region's industries throughout the nineteenth century and for most of the twentieth. There are also working examples of gas, oil, hot-air and diesel engines.

The **Air and Space Gallery**, a former market hall adjoining the station site, focuses on aircraft and motor vehicles. Highlights include the story of the pioneer aviator Alliott Verdon Roe and the Avro company, based at various sites around Manchester, from early triplane experiments to the ambitious aerospace visions of the early Cold War.

Drinks will be provided at this event.

For current activities at MOSI, visit the website: www.mosi.org.uk

For the changing appearance of the site, see [pinterest.com/mosimanchester/mosi-through-the-years/](https://www.pinterest.com/mosimanchester/mosi-through-the-years/)

For the history of the site, start with R S Fitzgerald, *Liverpool Road Station, Manchester: an historical and architectural survey*, Manchester University Press, 1980.

For the early development of the Museum, start with Richard Hills, "The North Western Museum of Science and Industry: some reminiscences", 2013, online at www.chethams.org.uk/digital_resources/north_western_museum_of_science_and_industry.pdf

Congress dinner

Event code: **J325**

Sat 27 July, 19:00–22:00 ▪ Manchester United Football Club

The official Congress Dinner will be held at Old Trafford stadium, the home of Manchester United Football Club.

The event will begin with a reception in the Manchester United Museum from 19.00. Split over three floors, the museum provides an in-depth and interactive guide to the history of the club, including United's greatest players, the drama of the 1998-99 Treble season, and the tragedy of the Munich air disaster. A three-course dinner will then be served in the stadium's Manchester Suite from 20.00.

There is also the opportunity to sign up for a tour of the stadium before the dinner. Old Trafford is the largest football club stadium in Britain, with a capacity in excess of 76 000. The tour takes visitors behind the scenes to view areas including the Sir Alex Ferguson Stand, the players' dressing room and the players' tunnel.

The Congress Dinner is available at a cost of £55 per person, and the optional stadium tour at £11 per person. You will need to reserve your place in advance by contacting mcc.reg@manchester.ac.uk.

Transport to and from Old Trafford is included in the price. Coaches will leave from University Place on Saturday afternoon at times to be announced.

Find out more about Manchester United and the Old Trafford ground at the website: www.manutd.com/en/Visit-Old-Trafford.aspx

ICOHTEC anniversary reception

Event code: **R326**

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

Mon 22 July, 17:45–18:45 ▪ Schuster Foyer

A special drinks reception marking the 40th anniversary of ICOHTEC, the International Committee for the History of Technology. The event will include the 2013 presentation of the ICOHTEC Prize for Young Scholars, awarded annually for a book-length work by a young researcher in the field.

Literary and Philosophical Society reception

Event code: **R327**

Sponsoring body:

Manchester Literary and Philosophical Society

Fri 26 July, 17:30–18:45 ▪ Schuster Foyer

This drinks reception follows the [screening of John Campbell's film](#) on Ernest Rutherford, who was one of the Manchester Literary and Philosophical Society's most prominent members in the early twentieth century. All are welcome to attend.

Women in Science Research Network launch

Event code: **R328**

Wed 24 July, 18:30–20:30 ▪ Manchester Museum

[WISNet](#), the Women in Science Research Network, is a project that brings historians, archivists and practising scientists together to research women's participation in science and learned societies in Britain since 1830. Our aim is to understand women's low visibility and historic exclusion, to uncover further avenues for research and to develop strategies to improve the participation of women in science today. This reception, held at the Manchester Museum, marks the international launch of the project.

All Congress delegates with an interest in women in science are welcome to register for this event. Places are limited, so it will be necessary to register in order to attend. Please register via the project website at http://womeninscience.net/?page_id=297.

History of Mathematics IUC reception

Event code: **R329**

Fri 26 July, 17:30–19:00 • Uni Place Restaurant

Annals of Science anniversary reception (invitation only)

Event code: **R330**

Wed 24 July, 17:30–19:00 • Uni Place 4.209

This anniversary reception celebrates the publication of the 70th volume of *Annals of Science* this year, and is hosted by the publisher of *Annals*, Taylor and Francis. Visit the Taylor and Francis stand in University Place to find out more about their full range of journals, enjoy discounts on books, and enter a free prize draw.

For more information, see the website:
www.tandfonline.com/r/history_of_science

The anniversary reception is an invitation-only event.

Music: The Noisy Frame. Lives of clothmakers in song and testimony, 1780-1840

Event code: **K331**

Mon 22 July, 21:00–22:30 • Jabez Clegg

The tumultuous changes and conflicts of the Industrial Revolution deeply affected the local populace in the North of England, and especially the cloth makers. The good times of the late eighteenth century, the Napoleonic wars, the violent reaction of Luddism to attempted mechanisation, and the beginnings of the factory system inspired them to produce ballads that now provide a precious heritage for folk musicians.

Based in the Pennine village of Slaithwaite, near Huddersfield, **Annie Dearman** (voice, Jew's harp) and **Steve Harrison** (melodeon, mouth organs, banjo) take us back to the noisy frame of the Industrial Revolution with songs, narratives and pictorial evidence all dating from those times. They have a particular love of songs that tell historical stories, in a robust and firmly rooted English style, taking their repertory from traditional singers, the folk song collectors, printed ballad sheets, and songs and tunes that they happen to hear and like.

This event is free to Congress attendees.

For further information, see the website: www.dearmanharrison.co.uk

Comedy: XS Malarkey

Event code: **K332**

Tue 23 July, 20:00–22:30 • Jabez Clegg

XS Malarkey is a multi-award winning comedy evening which takes place at the Jabez Clegg every Tuesday night. Reviewers have described the event as a 'rare treat' which offers the funniest performers in the country 'for the price of a kebab'. Over the years, some of the most successful British comedians (Phill Jupitus, Jason Manford, Jimmy Carr, Stewart Lee, Richard Herring, The Boy with Tape on his Face, Dave Spikey, John Bishop, Alan Carr, Jimmy Cricket, Peter Kay, Sarah Millican, Russell Howard, Mick Miller) have appeared on stage.

'Best bargain night out in Manchester. Five top comics for a laughable entry fee' – *The Guardian*

'The best comedy club in the country is also one of the cheapest.' – *BBC*

'Highly recommended – a strong tradition of pulling off pretty incredible bookings' – *Time Out*

'This thoroughly fine comedy club goes from strength to strength – and is still a bargain' – *Manchester Evening News*

This event is open to Congress attendees at a reduced charge of £3.

For more information, see the website: www.xsmalarkey.com

Comedy: Bright Club

Event code: **K333**

Wed 24 July, 21:00–22:30 • Jabez Clegg

Bright Club is the comedy gig where university lecturers and researchers try their hand at stand-up for the first time. It started off as an experiment at University College London, and soon spread virally across the country. The concept is to have a bunch of interesting comedians and musicians and combine them with fascinating people working in universities in front of an attractive and intelligent public audience. Whereas most academics will see their work published in leading journals, others will always remember the brilliant stories they could tell in front of their peers. The Manchester Congress provides the first opportunity for the first ever HSTM Bright Club: come along and find out more.

This event is open to Congress attendees at a cost of £2.

For more information, see the website: brightclub.wordpress.com

Compère: Steve CROSS | University College London, United Kingdom

With contributions from:

Chiara AMBROSIO | University College London, United Kingdom

Alexander HALL | University of Manchester, United Kingdom

Matthew PASKINS | University College London, United Kingdom

Jessica VAN HORSEN | York University, Canada

Charlotte WILDMAN | University of Manchester, United Kingdom

Music: Dave Haslam, Hacienda DJ

Event code: **K334**

Thu 25 July, 21:00–23:00 • Jabez Clegg

Popular music has been fundamental to Manchester's local culture since the days of the Industrial Revolution. In more recent years, however, Manchester music has found a place on the world stage through pioneering bands such as Joy Division/New Order, the Factory record label, and the seminal nightclub, FAC51 The Hacienda. The club was central to the acid house and rave scenes of the late 1980s and 1990s which radically transformed popular perceptions of the city, as stock visions of grimy Cottonopolis gave way to the vibrant 'Madchester' commemorated in the 2002 feature film, *24 Hour Party People*.

This club night is devoted to a set by DJ Dave Haslam, who presents a tour of the world of the Hacienda through its landmark tunes. Dave

Haslam made over 450 appearances at the Hacienda, from 1986 to the venue's final night in 1997, and has performed in Detroit, Berlin, Zurich, Ibiza, New York, Lima, and Geneva. He is also a writer, broadcaster and lecturer on the past and present of Manchester's popular culture, and in particular music. His book *Manchester, England* (London: HarperCollins, 1999) combines a historical survey with his own perspective as a witness to the radical changes that occurred in the city during the 1980s.

This event is open to Congress delegates at a reduced charge of £5.

For more information about Dave Haslam, see his website: www.davehaslam.com

This club night follows on from the special discussion session [Of music, engineers and drugs: when Cottonopolis became Madchester](#) on Wednesday afternoon. Dave Haslam will be speaking at this event and will be joined by musician Peter Hook (Joy Division/New Order), historian of technology Susan Schmidt Horning and historian of medicine James Mills. These event is free to all delegates.

Email Special (jazz)

Event code: **K335**

Sponsoring body:

ICOHTEC: International Committee for the History of Technology

[Fri 26 July, 21:00–23:00](#) ▪ Jabez Clegg

An international group of musicians, all historians of technology, that have played for the past eleven years at annual international symposia like ICOHTEC and others. Playing jazz, they got their name, The Email Special, for two reasons: because they largely decide what to play and rehearse via email, and as a variation of 'Air Mail Special', a tune made famous by Benny Goodman. The roots of this reach back to a symposium in Dresden (then East Germany) in the summer 1986.

The line-up: Hans-Joachim Braun (Germany), trumpet; Tony Stranges (Texas), vibes; Friedrich Naumann (Germany) and Jeremy Kinney (Washington, DC) sharing bass; John Stranges (New York), guitar; Sue Horning (Ohio), vocals; James Williams (Florida), piano. They will be joined by a local drummer from Manchester, and a couple of other colleagues may be sitting in.

iCHSTM tweetup

Event code: **R338**

[Mon 22 July, 18:00–19:30](#) ▪ Ducie Arms

Following on from the session on [Social media and public engagement](#) (E302), there will be a 'tweetup' at the [Ducie Arms](#), a traditional British pub just a stone's throw from the Congress venues. All attendees who use Twitter – or who are interested in starting to do so – are very welcome to come along, chat informally over drinks, and put faces to Twitter handles.

BSHS Dingle Prize lecture: David Wright, *Downs: the history of a disability*

Event code: **L341**

Sponsoring body:

BSHS Outreach and Education Committee

[Fri 26 July, 18:00–19:00](#) ▪ Manchester Museum

The [Dingle Prize](#) of the British Society for the History of Science is awarded every two years to 'the best book in the history of science (broadly construed) published in English... which is accessible to a wide audience of non-specialists.' The Prize reflects the Society's concern to communicate history of science to broad audiences.

The 2013 Dingle Prize has been awarded to [David Wright](#), Professor of History at McGill University, Canada, for his book [Downs: The History of A Disability](#) (Oxford University Press). The judges commented that Wright has produced 'a terrific book' and 'a little gem', which 'has valuable contributions to make to current debates' in the history of science and medicine.

This event consists of a talk by Professor Wright on the themes of his book, followed by questions, and is sure to provide a fascinating insight into the history of disability. The event is aimed at a general audience, but Congress attendees are welcome to come along and support the wider public reach of both the Congress and the field.

This event is free to all attendees.

Victorian science spectacular

Event code: **L342**

[Tue 23 July, 19:30–21:00](#) ▪ Portico Library

Roll up, roll up! What futuristic marvels amused the Victorians and Edwardians? A band of time-travelling professors present the cutting edge of science and technology from over a century ago. Be amazed and diverted by our phonograph, magic lantern, 'animated photographs', and chemical and electrical experiments from the 1800s. How have attitudes to innovation and the future changed since then? And how far has the Victorian blend of education with entertainment stayed with us?

Suitable for ages 12+. Funded by a 'Care for the Future' grant from the Arts and Humanities Research Council.

This public event has an admission fee of £5, except for students and retired attendees, who are admitted for free. Please make your own way to the Portico.

There will also be a free performance of this event, for Congress attendees only, on the University site on Tuesday morning: please see event E308 on the Special Sessions programme.

With contributions from:

[Aileen FYFE](#) | University of St Andrews, United Kingdom
[Iwan Rhys MORUS](#) | Aberystwyth University, United Kingdom
[Katy PRICE](#) | Queen Mary, University of London, United Kingdom
[Tim COCKERILL](#) | Freelance zoologist and circus performer, United Kingdom

The tables turned: Victorian séance event

Event code: **L344**

Sponsoring body:

BSHS Outreach and Education Committee

[Fri 26 July, 19:30–21:00](#) ▪ Portico Library

Organiser: Sabine CLARKE | University of York, United Kingdom

The Tables Turned is a public event that was developed by members of the British Society for the History of Science for audiences of young people. It has been performed several times over the last five years. The key aim is to explore the question 'How are facts made in science?' using a Victorian séance as its vehicle.

The Tables Turned uses role play in which performers in costume assume a number of roles, and the audience are encouraged to participate as members of the Manchester Literary and Philosophical Society. A meeting of the Society has been convened in 1860 to hear evidence by two eminent scientists, a poet and a journalist on their experiences of attending a séance. The audience are asked to consider evidence on the truth of such phenomena as table turning, the question of whether scientists should be called upon to judge such events and the reasons why little consensus emerged about the truth of spiritualism in the nineteenth century.

Come along to see a staging of the event, join in the role-play exercise and participate in discussion about exploring potentially difficult epistemological issues with non-specialist audiences.

This public event has an admission fee of £5, except for students and retired attendees, who are admitted for free. Please make your own way to the Portico.

There will also be a free performance of this event, for Congress attendees only, on the University site on Friday afternoon: please see event E310 on the Special Sessions programme.

Strange ice

Event code: **L345**

Sponsoring body:

Society for the History of Alchemy and Chemistry

Tue 23 July, 16:00–17:30 ▪ Room G51, Chemistry Building

Though you will find it in every refrigerator in the world, water ice is a material so strange that it breaks almost every rule in our textbooks. Chemist Andrea Sella delves into the intriguing world of ice, inspecting its properties and how it compares to other ices. Along the way we'll see how we came realize how little we really know about its structure, and wonder whether it may warn of a future much less certain than we imagine...

Andrea Sella is Professor of Inorganic Chemistry at University College London. Beyond his traditional research output, he is well known for his captivating demonstrations of chemical phenomena for schools, science festivals and other public audiences, and as a popular broadcaster. He also contributes the 'Classic Kit' column for *Chemistry World*. You can find out more at his [blog](#).

The Turing Machine Opera, with Decode/Recode (Monday performance)

Event code: **L346**

Sponsoring bodies:

Manchester Metropolitan University

City of Helsinki

Music Finland

Mon 22 July, 18:15–20:00 ▪ Capitol Theatre

The mathematician Alan Turing spent his final six years at the University of Manchester. Turing won little fame in his own lifetime, but is now seen to have made history in many ways across his extraordinary career. Turing conceptualised the universal machine which underpins the computer revolution, led the assault on the U-boat Enigma cipher during the Second World War, and made influential early explorations of the idea that machines might think. Turing was also ostracized for his sexual orientation, and his suicide remains one of the many mysteries of his life.

This event represents a unique opportunity to learn more about Alan Turing's life and career through outstanding performances uniting art, music, videos and media. Helsinki's *Ooppera Skaala* brings Turing to the stage with a multimedia opera weaving together soaring, emotionally charged vocal lines with atmospheric ambient soundscapes and sampled electronic rhythms. The intimate and intense opera for two singers and one dancer is set off by stunning 3D graphics.

The opera is performed in English.

- Based on the play *Turing* (2000) by Miko Jaakkola
- Libretto: Taina Seitovirta
- Composers: Eeppi Ursin and Visa Oscar
- Director: Janne Lehmusvuo

For further information about the Opera, see the website: www.oopperaskaala.fi/turing-machine/#more-226

Before the performance, guests will be given an opportunity to take part to the global networked interactive event **Decode/Recode**. Designed last year at Manchester Metropolitan University to celebrate the centenary of Alan Turing's birth, Decode/Recode is a collective media performance with interactive artworks, sound, lights, performers and VJs. Feel free to bring with you your own laptop, phone or internet-connecting device to be part of it!

For further information about Decode/Recode, see the website: decoderecode.tumblr.com

This event is open to registered Congress attendees and accompanying people at a charge of £10 (discounted from the general sale price of £15). The price includes a drink, provided in the Capitol Theatre before the performance. To reserve tickets, or for more information, please email boxoffice@ichstm2013.com.

Those attending may also be interested in a [short walk about Turing](#) taking place on Monday lunchtime, which will visit two of the locations on the old University of Manchester campus which were a focus for Turing's work.

The Turing Machine Opera, with Decode/Recode (Tuesday performance)

Event code: **L347**

Sponsoring bodies:

Manchester Metropolitan University

City of Helsinki

Music Finland

Tue 23 July, 18:15–20:00 ▪ Capitol Theatre

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the old University of Manchester campus which were a focus for Turing's work.

Chemists, brewers and beer-doctors

Event code: **L348**

Wed 24 July, 20:00–20:45 ▪ Jabez Clegg

Organiser: James SUMNER | University of Manchester, United Kingdom

Is 'chemical beer' an idea to fear?

Many manufacturers in the eighteenth and nineteenth centuries said not. Their innovations in colouring, antacids and synthetic sugars, they said, would help the brewers to make a traditional product more reliably and at a lower price.

Many drinkers disagreed. A secret army of 'brewers' druggists', they claimed, was replacing the traditional goodness of malt and hops with mysterious nostrums to cheat the public – and possibly far worse. Periodic panics swirled through newspapers and pamphlets, alleging widespread fatal poisoning by strychnine, opium or deadly nightshade.

This public talk includes a live demonstration of the old-style art of the 'beer doctors'. Dr James Sumner, author of *Brewing Science, Technology and Print, 1700-1880*, will subject a blameless modern-day pint to a variety of (strictly non-toxic but less than pleasant) chemical interventions, and encourage the audience to do the same. Or not. As they prefer. (Most typically prefer not to.)

Come along and find out how the reputations of chemists suffered and resurfaced; how the authorities (who weren't so concerned about poisons, but drew the line at tax-dodging) responded; and why Humphry Davy ended up as a witness in an 1809 court case about the rights and wrongs of brewing with stinking fish.

James Sumner is lecturer in the history of technology at the University of Manchester, and co-chair of the Local Organising Committee for the Congress. He has worked enough 16-hour days on the Congress programme to be allowed to plug his book on this page.

Jodrell Bank Observatory excursion (Monday)

Event code: **X221**

Mon 22 July, 09:15–13:00

Internationally, the Jodrell Bank Observatory may be known chiefly to astronomers. In the UK, it is a cultural phenomenon, standing for more than half a century as an icon of scientific and technological enterprise.

Jodrell Bank will forever be associated with [Sir Bernard Lovell](#) (1913–2012), its founding director and the long-term leader of the University's radioastronomy project. After developing radar systems in the Second World War, Lovell returned to Manchester to work on cosmic ray detection – initially on the old campus site across Oxford Road from the Congress venue.

Jodrell Bank entered history thanks to the electric tramcars running up and down Oxford Road, which interfered persistently with the detector

equipment. Enquiring after quieter University-owned sites led Lovell to what was then a research outpost of the Department of Botany, a little over 30km away in the flat farming country of Cheshire. Astrophysics soon became the main business of the site – though its origins and setting are reflected in features such as an arboretum, established under Lovell's direction in the 1970s.

Jodrell Bank as an icon, however, reduces to one image: the vast dish of the Mark 1 radio telescope towering incongruously over the Cheshire plain. 76 metres in diameter, it was by far the largest steerable dish in the world at the time of its 1957 completion (it is presently the third-largest). The assembly is one of the grandest examples of the thrifty repurposing of wartime surplus: two huge gun turret bearings, reclaimed from battleships, became its altitude rotators.

The costs of the telescope project overran hugely, threatening disaster for Lovell and the University. With fairytale timing, however, the detector became operational days before the Soviet Union's launch of Sputnik 1, the first artificial satellite, and was the only device on earth capable of tracking Sputnik's carrier rocket. Lovell showed great skill in handling both policy-making and public audiences as he built on this opportunity

to weave an integral role for the Observatory in the technoscientific infrastructure of the Cold War.

Over the years, the regular appearance of Bernard Lovell and the dish in popular books, films and television cemented both as perennial reference-points in the consciousness of the nation. Science-fiction audiences of the 1950s thrilled to the exploits of [Professor Bernard Quatermass](#), named in Lovell's honour, just as a later generation stared as Tom Baker, the longest-running star of *Doctor Who*, took his final bow with a [dramatic fall](#) from what – though not named as such – is unquestionably a representation of the leviathan dish.

Today, the Observatory site is managed as part of the Jodrell Bank Centre for Astrophysics within the University of Manchester. Reflecting the trend to ever-larger and more spatially distributed data-gathering systems, the Centre serves as the hub for [e-MERLIN](#), the British contribution to the European VLBI Network collaboration, and the headquarters of the international [Square Kilometre Array](#) consortium. Yet the towering dish, and the immense public recognition and even affection it inspires, have also cemented the site as a base for public and widening-participation activities via the [Jodrell Bank Discovery Centre](#) on site.

Our visit includes a tour of the site with access to the Space Pavilion exhibition, Planet Pavilion gallery (including a newly installed [mechanical orrery](#)), gardens and arboretum.

This excursion is only available by prior reservation through the University's conference services office: please reserve your place at the time of registration for the Congress, or contact mcc.reg@manchester.ac.uk for further information. There is a charge for this excursion.

Coaches will run from outside University Place directly to Jodrell Bank, returning in time for lunch.

For present-day astronomy research, see the Observatory website at www.jb.man.ac.uk.

For current public activities, see the Jodrell Bank Discovery Centre website at www.jodrellbank.net.

For the history of the Observatory and its public representation, start with [Jon Agar](#), *Science and spectacle: the work of Jodrell Bank in postwar British culture*, Harwood Academic 1998.

For a focus on the physical development of the site, and its role in cultural memory, see [Mark Edmonds](#), 'When they come to model Heaven: big science and the monumental in post-war Britain', *Antiquity* 84 (2010), 774-795.

Jodrell Bank Observatory excursion (Tuesday)

Event code: **X222**

Tue 23 July, 09:15–13:00

See details for X221.

Jodrell Bank Observatory excursion (Wednesday)

Event code: **X223**

Wed 24 July, 09:15–13:00

See details for X221.

Jodrell Bank Observatory excursion (Thursday)

Event code: **X224**

Thu 25 July, 09:15–13:00

See details for X221.

Jodrell Bank Observatory excursion (Friday)

Event code: **X225**

Fri 26 July, 09:15–13:00

See details for X221.

Chatsworth House excursion

Event code: **X231**

Thu 25 July, 09:30–17:30

Among the grand stately homes of England, Chatsworth House in Derbyshire has a claim to be the grandest. Home to a powerful social and political dynasty spanning five centuries, it retains spectacular architecture and landscaping and houses a vast collection of artworks and other artefacts. Among these is a crucial connection to the history of science: the library of Henry Cavendish, on some measures the most influential English natural philosopher of his day.

From its beginnings in the 1550s, the house has been in the hands of the Cavendish family. The original Sir William Cavendish (c. 1505-1557) was a courtier who married the well-connected [Bess of Hardwick](#), a Derbyshire native who developed both Chatsworth and nearby [Hardwick Hall](#). Mary, Queen of Scots spent several periods as a guest/prisoner at the house during Bess's time.

Though the original Tudor Chatsworth was already among the grand projects of its day, it was greatly remodelled and extended under a later William Cavendish (1640-1707), fourth Earl of Devonshire. A strong Whig in politics, Cavendish was prominent in the movement to remove King James II and secure the Protestant succession by any means necessary, including rebellion. After a violent altercation at Court and subsequent trial, he retired to Chatsworth and began rebuilding in 1687, in expectation of a period of internal exile.

This work had not long been under way, however, when a group including Cavendish successfully engineered the Revolution of 1689. With his chosen man now King as William III, Cavendish – soon promoted to Duke of Devonshire – found himself in the unaccustomed role of loyalist, with opportunities to spend freely on lavish displays of loyalty. The imposing frontages on all sides and the baroque state apartments, intended for a royal visit, date from this period, as does the extraordinary Cascade, an artificial waterfall of stone steps.

Though several of the family were active in natural philosophy, the most influential by far was [Henry Cavendish](#) (1731-1810), a grandson of the second Duke, best known today for identifying the 'inflammable air' subsequently reinterpreted as hydrogen. Widely reported to be painfully shy and almost reclusive in his personal life, Henry nonetheless carved out a career as one of the most eminent organisers of collaborative scientific enquiry of his day, aided by his early introduction to bodies such as the Royal Society and vast inherited wealth. His work spanned electricity, heat, the composition of water and airs, astronomical and

terrestrial surveying, and the famous 'Cavendish experiment' using a torsion balance, intended to determine the mass of the Earth.

Though Henry was never a Chatsworth resident, the House is now home to his vast collection of 12 000 books on natural-philosophical subjects. After his death, this collection passed through the family to the sixth Duke (1790-1858), an avid collector who added a full wing to the house and performed extensive renovations to house his mineral specimens, sculptures and books. Chatsworth also holds personal papers of Henry Cavendish including the 'White Book', the only known surviving notebook of his chemical and mineralogical studies.

The sixth Duke also comprehensively reshaped the grounds surrounding the House. His gardener, Joseph Paxton, oversaw the re-laying of the gardens and the addition of such spectacular features as the arboretum, rockeries, and the Emperor Fountain, built for an unrealised visit by Tsar Nicholas I: fed by a purpose-built lake on the moors above Chatsworth, its single water jet has on occasion played to a height of 90 metres.

The upkeep of all this grandeur was, of course, fabulously expensive, and the social and economic upheavals of the twentieth century left the traditional pattern of life at Chatsworth entirely unmanageable. Like most surviving stately homes, it now survives primarily as a public visitor attraction. Unlike many similarly grand properties, however, Chatsworth is cared for not by the National Trust, but by a private charitable trust which leases part of the property to the current generation of Cavendishes, who continue to make it their home.

This excursion is only available by prior reservation through the University's conference services office: please [reserve your place at the time of registration](#), or contact mcc.reg@manchester.ac.uk for further information. There is a charge for this excursion.

This is a full-day trip. Coaches will run from outside University Place directly to Chatsworth, returning in time for the evening reception. A packed lunch is provided and included in the reservation cost.

For more information about Chatsworth today, see the website: www.chatsworth.org. The [Art, library and archives collections](#) pages are useful on the House's collections, and the [Chatsworth Library Project](#) has its own blog.

For the life and work of Henry Cavendish, start with [Christa Jungnickel and Russell McCormach, *Cavendish: the Experimental Life*](#) (Bucknell University Press, 1999).

Quarry Bank Mill and Styal Estate excursion

Event code: **X232**

Thu 25 July, 12:45–17:30

Quarry Bank Mill at Styal, in the Cheshire countryside just over 15km from central Manchester, is a superbly preserved example of an Industrial Revolution-era cotton mill with its settlement of workers' housing. Owned by the [National Trust](#), it has been partially adapted as a museum of the cotton industry.

Erected in 1784, the Mill represents a period when the convenience of water supply for power still determined the geography of industry: a long channel from the nearby River Bollin turned the original wooden wheel. As production expanded, more wheels were added, iron replaced wood, and the valley above the Mill was dammed to create a reservoir. The present-day wheel, though not original to Quarry Bank, is an authentic textile mill-wheel reclaimed from a site in Yorkshire, and the most powerful working waterwheel in Europe. Displays in the Mill building include live demonstrations of spinning and weaving technology using authentic equipment.

The site also includes extensive grounds, gardens, and the Apprentice House, home to the pauper child 'apprentices' (effectively, unpaid labourers) who worked the site in the first half of the nineteenth century. The mill-owner Samuel Greg and his successors were enthusiastic social reformers; admirers saw their child-labour policy as providing a clean and healthy alternative to the typical workhouse through the innovation of dedicated medical care. To reformers of later generations, however, they summed up the routine exploitation and cruelty of their era. Costumed interpreters give regular guided tours exploring the working lives of the apprentices and others who worked the site.

This excursion is only available by prior reservation through the University's conference services office: please [reserve your place at the time of registration](#), or contact mcc.reg@manchester.ac.uk for further information. There is a charge for this excursion.

This is a half-day (afternoon) trip. Coaches will run from outside University Place directly to Quarry Bank Mill, returning in time for the evening reception. A packed lunch is provided and included in the reservation cost.

For more information, please see the website:

www.nationaltrust.org.uk/quarry-bank-mill/

Museum of Science and Industry tours, plus: meet the curators and archivists

Event code: **X233**

Thu 25 July, 14:00–17:00 • Museum of Science and Industry

On Thursday afternoon, ahead of the [Museum of Science and Industry evening reception](#), MOSI offers a relaxed and informal opportunity to look behind the scenes. Explore the archives, galleries and reserve collections with an expert guide, find out what we can do to help your research, or just enjoy the experience of exploring the museum in depth and sharing ideas with colleagues and MOSI's curators and archivists and curators from the Science Museum in London as we tour together.

Introduction to the MOSI Archive

Sessions begin at 14:00, 15:00 and 16:00 Maximum 15 people per session.

Come along to the Study Area to find out about MOSI's archive collections. Our extensive holdings demonstrate the relationship between scientific knowledge and industrial production and how this relationship put Manchester on the map as a place where science, innovation and industry created modern society. A selection of archives will be on display in the Study Area, and you'll have the chance to talk to the archives team in depth to see how we can help meet your research needs.

For more information, see the website:

www.mosi.org.uk/collections/using-the-collections/using-the-archives.aspx

or contact MOSI directly: collections@mosi.org.uk

Scientific instruments and Collections Centre tours

Sessions begin at 14:00 and 16:00. Maximum 15 people per session.

Explore MOSI's Collections Centre on a guided tour of the object cabinets and stores. Explore our scientific instrument collections, see equipment used by famous scientists James Joule and John Dalton, and learn their stories.

WALKS, TOURS AND EXCURSIONS

For more information, see the website:

www.mosi.org.uk/collections/using-the-collections/collections-centre.aspx

Energy galleries tour

14:00. Maximum 15 people.

A technological age needs a complex energy system. This curator-led tour takes in MOSI's wide-ranging electricity and gas collections to tell the story of how engineers built energy systems and how consumers responded to innovation and drove demand.

For more information, see the website:

www.mosi.org.uk/explore-mosi/explore-galleries/electricity-gallery.aspx

www.mosi.org.uk/explore-mosi/explore-galleries/gas-gallery.aspx

Industry and Cotton gallery tour

15:00. Maximum 15 people.

Manchester was Cottonopolis: the world's first industrial city, and at the centre of the global textile trade. Find out how it rose and fell, see fascinating cotton making machines at work, and discover how Manchester's ambitions founded the first modern industrial estate at Trafford Park, and the engineering trades that went on there.

For more information, see the website: www.mosi.org.uk/explore-mosi/explore-galleries/textiles-gallery.aspx

Transport gallery tour

16:00. Maximum 15 people.

Find out the stories behind magnificent aircraft and motor cars in MOSI's Air and Space Hall and learn about the fascinating history of aviation in the north-west, and how the region has helped the United Kingdom defend itself in war, take holidays, and even reach into space.

For more information, see the website: www.mosi.org.uk/explore-mosi/explore-galleries/air-space-gallery.aspx

There is no charge for any of these tours and events. As numbers are limited, please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

Campus history walk: physics

Event code: **M240**

Mon 22 July, 13:00–13:45 ▪ Manchester Museum

Organiser: Neil Todd | University of Manchester, United Kingdom

This tour will focus in particular on the 1900 laboratory designed by Arthur Schuster, the physicist who took the lead in the development of the independent University of Manchester and brought physics to the centre of the University's international profile. The design of the laboratory looked to the best German and American models, integrating new developments in 'electro-technics' (the field from which electrical engineering emerged).

From 1907 to 1919, the laboratory was home to Ernest Rutherford and a stellar group of researchers including Niels Bohr, Henry Moseley, Hans Geiger, George de Hevesy and Ernest Marsden. Each year brought major new discoveries, including the atomic nucleus in 1911, the establishment of atomic number and the quantum atom in 1913 and transmutation in 1919.

After the war, Rutherford was succeeded by the crystallographer Lawrence Bragg, and radioactivity research largely disappeared to Cambridge – although traces of radioactivity remained. Bragg's successor in 1937 was Patrick Blackett, who established cosmic ray research in Manchester, culminating in the discovery of strange particles by Rochester and Butler in 1947. Blackett also began his work on geomagnetism here, whilst playing a major part in the reconstruction of the University after the Second World War.

The arrival of Sam Devons in 1955, the last of Rutherford's students, signalled Manchester's nuclear renaissance, as a number of particle accelerators were constructed. After Devons' early departure in 1960, leadership passed to the theoretician, Brian Flowers, and in 1967 the Physics Department moved to the present laboratory named in honour of Schuster – the site of many Congress sessions – on the east side of Oxford Road.

Part of Schuster's original 1900 laboratory, meanwhile, was occupied for a time by Psychology, before being renovated for administration in 2004; it has since been renamed the 'Rutherford Building', and some of the historically important rooms are available to visit.

The walk will be led by **Dr Neil Todd**, a physicist, neuroscientist, and radio-archaeologist of modern physics.

There is no charge for this walk. Numbers will be limited, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

Campus history walk

Event code: **M241**

Mon 22 July, 17:45–18:30 ▪ Manchester Museum

Organisers:

John PICKSTONE | University of Manchester, United Kingdom

James HOPKINS | University of Manchester, United Kingdom

This walk presents a quick general survey of science, technology and medicine on the campus since 1873. We will begin with the oldest buildings, designed by Alfred Waterhouse for Owens College, which had been founded in 1851 but had rapidly outgrown its original premises in a house in the city centre. Around these grew the extensions for Natural History and the Manchester Museum, and the ever grander buildings for a Library and the ceremonial hall, both of which owed much to the fortune of the Manchester engineer Joseph Whitworth, famous for standard screws, very flat planes and best-selling guns.

We will then follow the growth of scientific departments, beginning with chemistry and the Medical School and moving onto engineering (dominated, in the early twentieth century, by Osborne Reynolds) and mathematics (Horace Lamb developed his work on hydrodynamics here), and then to physics, including Ernest Rutherford's stellar group, and 'electro-technics', incorporating the Manchester Computer of 1948.

Here is a chance to consider *in situ* the University community of the time before the First World War, which included not only Rutherford, Lamb and Niels Bohr but Chaim Weizmann (fermentation chemist and Zionist), Grafton Elliot Smith (anatomist and Egyptologist), and the young Marie Stopes (as a palaeobotanist) and Ludwig Wittgenstein (as a student of engineering). On the same streets around 1950 you might have met the computer builders Freddie Williams and Tom Kilburn, the computer theorist and user Alan Turing, and his mathematical patron, Max Newman. In the physics department was the Dean of Science, Patrick Blackett and the young Bernard Lovell, then building the famous radio-astronomy 'Big dish' at Jodrell Bank. Across Oxford Road, on Dover Street, was a group of noted social scientists and Africanists, including Max Gluckmann; and there among the economists was

Blackett's good friend and political opponent, the physical chemist turned philosopher Michael Polanyi, whose work in Manchester on 'tacit knowledge' was to contribute hugely to the emergence of the field of science studies.

The walk will be led by **Professor John Pickstone**, emeritus, founding Director of the Centre for the History of Science, Technology and Medicine, and advisor on university heritage; and/or by **Dr James Hopkins**, the University's heritage officer.

There is no charge for this walk. Numbers will be limited, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

Campus history walk: chemistry

Event code: **M242**

Tue 23 July, 13:00–13:45 ▪ Manchester Museum

Chemistry was the key science in Victorian Manchester, and Manchester was a key site in British chemistry from John Dalton (1766-1844) through the Second World War. This campus tour will include the fine (former) laboratories established by Henry Roscoe in 1873 as he helped lead the expansion of Owens College to full University status. Nearby are the labs associated with the organic chemists Carl Schorlemmer, William Henry Perkin Junior, Chaim Weizmann, Robert Robinson and Alexander Todd, and with the physical chemistry of HB Dixon and Michael Polanyi. Alongside them is the Schunck Building, once the home in North Manchester of the noted industrialist and authority on biological pigments, Edward Schunck: this building, which contained his private laboratory and library, was moved to the present site after his death.

We will also visit the historical displays in the new chemistry laboratories on Brunswick Street, which include Jacob Epstein's bust of Weizmann and information about Manchester's many winners of the Nobel Prize for Chemistry. These laboratories stand, appropriately, on the site of the birthplace of J T Merz, chemist and pioneering historian of nineteenth-century science and philosophy!

The walk will be led by **Dr Diana Leitch**, a chemist, former Deputy Director of the University of Manchester's Library, and historian of both chemistry and Manchester, Fellow of the Royal Society of Chemistry and a member of the RSC Historical Group.

There is no charge for this walk. Numbers will be limited, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

Campus history walk

Event code: **M243**

Tue 23 July, 17:45–18:30 ▪ Manchester Museum

See details for M241.

Campus history walk: North Campus

Event code: **M244**

Wed 24 July, 13:00–14:30 ▪ Manchester Museum

Organiser: John Pickstone | University of Manchester, United Kingdom

Longer than the other campus tours, this visit will take us away from Oxford Road to the northern end of the University's long, loosely contiguous campus: we will visit what were historically quite distinct parts of the city's teaching and research facilities, and which should be of particular interest to historians of technical education.

Depending on conditions, we may visit the 1856 building of the Mechanics Institute, later a Technical school, which housed the founding meeting of the Trades Union Congress in 1868. We will focus, however on the grand 1902 building of the Manchester Technical College, modelled on German Polytechnics – including the wonderfully chauvinistic stained glass windows in the Great Hall.

To the south of this building stand the distinctive white modernist structures which accommodated the expansion of the 'Tech', after the Second World War, into an exclusively university-level institution which gained a world reputation: UMIST, the University of Manchester Institute of Science and Technology. Avowedly independent, in most respects, from the (Victoria) University of Manchester on Oxford Road, UMIST was nevertheless brought into a merger with its neighbour in 2004, creating the UK's largest single-site University campus.

The walk will be led by **Professor John Pickstone**, emeritus, founding Director of the Centre for the History of Science, Technology and Medicine, and advisor on university heritage.

There is no charge for this walk. Numbers will be limited, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

Campus history walk

Event code: **M246**

Thu 25 July, 13:00–13:45 ▪ Manchester Museum

See details for M241.

Campus history walk: physics

Event code: **M247**

Fri 26 July, 13:00–13:45 ▪ Manchester Museum

See details for M240.

Campus history walk: chemistry

Event code: **M248**

Fri 26 July, 17:45–18:30 ▪ Manchester Museum

See details for M242.

Campus history walk: biology and medicine

Event code: **M249**

Sat 27 July, 13:00–13:45 ▪ Manchester Museum

Organiser: **John PICKSTONE** | University of Manchester, United Kingdom

From the beginning of Owens College in 1851, natural history (encompassing botany, zoology and geology) was taught by a local doctor, W C Williamson, who had been raised among the keen amateur geologists of Yorkshire. Our tour will touch on the Manchester Museum, of whose collections the young Williamson was at one time curator. Next to the Museum, and also built in the 1880s, are the Beyer laboratories, where specialist geologists and zoologists successively took over parts of Williamson's domain. Williamson himself developed a focus on palaeobotany, and in particular that of the local coal measures: this specialism was continued by Marie Stopes, who lectured here from 1905 before becoming known for *Married Love* and birth control.

Owens College gained a medical school in 1874, when an established proprietary school in the city was incorporated into the new College site on Oxford Road. The tour will also include the 1890s buildings associated with important public health bacteriology, and with the ultra-diffusionist cultural 'history' of the anatomist and Egyptologist Grafton Elliot Smith, not forgetting the discovery of the hormone pancreozymin! But in Manchester, as in most of the medical schools of industrial England – and unlike Cambridge – it was the clinicians who dominated the Faculty.

The walk will be led by **Professor John Pickstone**, emeritus, founding Director of the Centre for the History of Science, Technology and Medicine, and advisor on university heritage.

There is no charge for this walk. Numbers will be limited, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

Manchester Museum tour

Event code: M351

Mon 22 July, 12:00–13:00 ▪ Manchester Museum

Part of the University of Manchester, the Manchester Museum is the largest university museum in the UK. It holds 4.5 million objects, and attracts around 350 000 visitors each year. The Museum developed from the collections of the Manchester Natural History Society and the Manchester Geological Society in the mid-nineteenth century. Its present site, opened to the public in 1888, was developed as part of Owens College (the forerunner of the University of Manchester), with distinctive neo-Gothic buildings designed by Alfred Waterhouse and his successors; the Museum has been expanded repeatedly, and was significantly modernised in 2000-03. In recent years, early galleries have been comprehensively redeveloped to produce the **Living Worlds**, **Ancient Worlds** and **Nature's Library** displays. The Museum plays a key role in delivering the University's social responsibility agenda and is heavily used for student teaching. This tour presents the opportunity to find out more about the building and the collections with a member of the Museum's staff.

There is no charge for this walk. Numbers will be limited to 15 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

For current activities at the Manchester Museum, please see the website at www.museum.manchester.ac.uk or follow [@McrMuseum](#) on Twitter.

For the history of the Manchester Museum, start with Samuel J M M Alberti, *Nature and Culture: Objects, Disciplines and the Manchester Museum*, Manchester University Press, 2009.

Manchester Museum tour

Event code: M352

Mon 22 July, 13:00–14:00 ▪ Manchester Museum

See details for M351.

Ordsall Hall Gardens tour

Event code: X353

Tue 23 July, 11:00–12:00 ▪ Ordsall Hall

Ordsall Hall stands on the site of an ancient manor house, visited by the humanist scholar Erasmus in 1499, and parts of its fifteenth-century construction survive. Now managed by Salford City Council and open to the public, its attractions include landscaped ornamental gardens and an organically managed heritage garden cultivating historic varieties of flowers, vegetables and herbs.

This guided tour highlights the weird and wonderful remedies of the sixteenth and seventeenth centuries, displaying many plants used for culinary, medicinal and dyeing purposes. Head Gardener Lindsay Berry will highlight some of the more unusual applications, including remedies to treat pleurisy, leprosy, piles and those to 'open obstructions of the brain!' Some of the concoctions discussed will be available to try for those participants feeling brave enough.

There is no charge for this walk. Numbers will be limited to 15 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#). Please arrange your own travel to Ordsall Hall.

For more information about Ordsall Hall Gardens, please see the website at www.salfordcommunityleisure.co.uk/culture/ordsall-hall/gardens or follow [@VisitSalford](#) on Twitter.

Imperial War Museum North tour: 'Saving Lives'

Event code: X354

Tue 23 July, 15:00–15:30 ▪ Imperial War Museum North

On the edge of the Trafford Park industrial zone – a major target for bombers in the Second World War – the Imperial War Museum North opened in 2002. Its distinctive structure, designed by Daniel Libeskind, consists of shard-like projections, symbolising the fractures caused by conflict; its displays address the effects of war on the lives of service personnel and civilians around the world.

This guided tour explores **Saving Lives: Frontline Medicine in a Century of Conflict**, a major temporary exhibition exploring the interrelation of warfare and medicine from the First World War to the present. Learn about Major Margaret Barclay-Cooke, a nursing officer with the Queen Alexandra's Royal Army Nursing Corps, who, faced with sub-zero temperatures and basic conditions, transformed a disused operating theatre to treat patients in the immediate aftermath of the Falklands War. Find out about the production and distribution of penicillin at ICI in Trafford Park, in the Second World War and about Archibald McIndoe, pioneer of surgical reconstruction methods, whose whose RAF patients became known as the 'Guinea Pig Club'.

There is no charge for this tour. Please email tours@ichstm2013.com giving your name and the date and time of the tour.

Numbers will be limited to 20 people per tour. Please arrange your own travel to the Imperial War Museum North.

For more information about the exhibition, please see the website at www.iwm.org.uk/exhibitions/iwm-north/saving-lives or follow [@I_W_M](https://twitter.com/I_W_M) on Twitter.

Manchester Museum tour

Event code: **M355**

Tue 23 July, 12:00–13:00 • Manchester Museum

See details for M351.

Manchester Museum tour

Event code: **M356**

Tue 23 July, 13:00–14:00 • Manchester Museum

See details for M351.

Manchester Museum herbarium tour

Event code: **M357**

Tue 23 July, 12:00–13:00 • Manchester Museum

The herbarium of the Manchester Museum houses one of the most extensive collections of preserved plants in the UK, with around 1 million herbarium sheets. These represent an archive of information on biodiversity, and a record of the natural environment over the last 200 years. This tour presents the opportunity to find out more about the herbarium with a member of the Museum's staff.

There is no charge for this walk. Numbers will be limited to 15 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the Congress Events Desk.

For more information about the herbarium, please see the website at www.museum.manchester.ac.uk/collection/plants or follow [@Aristolochia](https://twitter.com/Aristolochia) on Twitter.

Guided walk: Manchester peace and justice trail

Event code: **X358**

Tue 23 July, 14:00–16:30 • Bridgewater Hall

This walk will cover sites connected to the growth of Manchester as the world's first industrial city and its importance as a centre for radical political activity, addressing themes including the popular reform movement, slavery, religious tolerance, migration, and gay rights. Locations will include Peterloo, the former Free Trade Hall, Manchester Town Hall, the Abraham Lincoln statue, historic libraries, the Hidden Gem and sites associated with Alan Turing.

The walk is led by **Steve Roman**, a trustee of The Victorian Society. He helped to create the Manchester Peace and Social Justice Trail, linking his Manchester cultural identity and his lay interests in history, politics

and architecture with his campaigning on issues of peace and social justice.

There is no charge for this walk. Numbers will be limited to 30 people per walk, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the Congress Events Desk.

The walk starts outside the main entrance of the Bridgewater Hall on Barbirolli Square. Please arrange your own travel to the start point.

For more information about the Peace and Justice Trail, please see the website at www.manchesterpeacetrail.org.uk

Working Class Movement Library tour

Event code: **X359**

Wed 24 July, 12:00–13:00 • Working Class Movement Library

The Working Class Movement Library in Salford records over 200 years of organising and campaigning by ordinary men and women. This guided tour will discuss its extensive holdings on the growth of trade unions, socialist and co-operative organisations. The early Owenites and Socialists had a thirst for a wide education, including science and technology.

Visitors will also be able to see the exhibition developed to coincide with the Congress, showing the development of public and occupational health and campaigns to improve working conditions. The exhibition will also look at the role of scientists in the socialist and peace movements, featuring subjects including naturalist Alfred Russel Wallace in the year of the centenary of his death.

There is no charge for this walk. Numbers will be limited to 10 people per tour, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the Congress Events Desk. Please arrange your own transport to the Working Class Movement Library.

Heritage bus trip and tour of the Museum of Transport

Event code: **X360**

Wed 24 July, 13:30–16:30 • Museum of Transport

Discover Greater Manchester's public road transport history in appropriate style with a trip to the Museum of Transport at Cheetham Hill. A heritage double-decker bus will collect you from the Congress site, transport you to the Museum and return you after your visit. On arrival at the Museum, you will receive a guided tour of one of Britain's biggest collections of restored buses, coaches and trams. From a Victorian horse drawn bus to the prototype Metrolink tram, you will be able to see and sit in fascinating vehicles that took Greater Manchester folk to work, shops and outings to the coast and countryside. The Museum has its own tea room, and a shop selling models, books and other souvenirs.

There is a charge of £2 for this tour, which includes the round-trip bus journey and admission to the Museum. Numbers will be limited to 64 people in total. Please register in advance: you can do this at any time before the Congress by emailing tours@ichstm2013.com

WALKS, TOURS AND EXCURSIONS

with your details; or you can sign up in person at the [Congress Events Desk](#).

For more information about the Museum of Transport, please see the website at www.gmts.co.uk, Facebook account at facebook.com/motgm or videos on Youtube at <http://www.youtube.com/motgm>, or follow @MoTGM on Twitter.

People's History Museum tour

Event code: **X361**

Wed 24 July, 14:00–15:00 • People's History Museum

The People's History Museum is the national museum of democracy, the only museum in the UK dedicated to telling the story of the development of democracy in Britain and how ordinary people have achieved extraordinary things through co-operation. It has been based in Manchester since 1990, and works to encourage the widest range of users to explore the history and achievements of working-class people in Britain. This special guided tour will focus on elements of the collections and gallery displays related to Congress themes.

There is no charge for this tour. Numbers will be limited to 15 people per tour, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#). Please arrange your own travel to the People's History Museum.

For more information about the Museum, please see the website at www.phm.org.uk, or follow @PHMMcr on Twitter.

Imperial War Museum North tour: 'Saving Lives'

Event code: **X362**

Wed 24 July, 15:00–15:30 • Imperial War Museum North

See details for X354.

Manchester Museum tour

Event code: **M363**

Wed 24 July, 12:00–13:00 • Manchester Museum

See details for M351.

Manchester Museum tour

Event code: **M364**

Wed 24 July, 13:00–14:00 • Manchester Museum

See details for M351.

Guided walk: Victorian and Edwardian Manchester

Event code: **X365**

Thu 25 July, 14:00–16:30 • Bridgewater Hall

Manchester became an international phenomenon in the eighteenth and nineteenth centuries as it spearheaded the Industrial Revolution. It was a centre of technological innovation, radical politics and global commerce, championing political reform, the abolition of slavery and international free trade. This walk will take visitors through two distinct areas of the city centre. In Castlefield, we will experience industrial infrastructure including the first canals, railways and warehouses dating from the 1760s. We will then see some of the very fine commercial and civic buildings which illustrate the growing wealth and status of the city in the nineteenth century.

The walk is led by **Ken Moth**, an architect with a long-term interest in many aspects of history and in the re-use of historic buildings.

There is no charge for this walk. Numbers will be limited to 25 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

Guided walk: Manchester peace and justice trail

Event code: **X366**

Thu 25 July, 14:00–16:30 • Bridgewater Hall

This walk will cover sites connected to the growth of Manchester as the world's first industrial city and its importance as a centre for radical political activity, addressing themes including the popular reform movement, slavery, religious tolerance, migration, and gay rights. Locations will include Peterloo, the former Free Trade Hall, Manchester Town Hall, the Abraham Lincoln statue, historic libraries, the Hidden Gem and sites associated with Alan Turing.

The walk is led by **Steve Roman**, a trustee of The Victorian Society. He helped to create the Manchester Peace and Social Justice Trail, linking his Manchester cultural identity and his lay interests in history, politics and architecture with his campaigning on issues of peace and social justice.

There is no charge for this walk. Numbers will be limited to 30 people per walk, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

The walk starts outside the main entrance of the Bridgewater Hall on Barbirolli Square. Please arrange your own travel to the start point.

For more information about the Peace and Justice Trail, please see the website at www.manchesterpeacetrail.org.uk

Working Class Movement Library tour

Event code: **X367**

Thu 25 July, 12:00–13:00 • Working Class Movement Library

See details for X359.

Police Museum tour

Event code: **X368**

Thu 25 July, 13:30–15:30 • Police Museum

The Greater Manchester Police Museum and Archives is set in the former Newton Street Police Station, opened in 1879. This guided tour of the Museum will take in the original station charge office and cells – which include original wooden beds and wooden pillows – and also a Victorian Magistrates' Court, which was rescued from nearby Denton Police Station, restored and installed at the museum. The museum also features galleries of uniform and equipment, crime and criminal investigation and a small collection of police motorcycles.

There is no charge for this visit. Numbers will be limited, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the Congress Events Desk. Please arrange your own transport to the Police Museum.

For more information about the Museum, please see the website at www.gmpmuseum.com, or follow [@GMPMuseum](https://twitter.com/GMPMuseum) on Twitter.

People's History Museum tour

Event code: **X369**

Thu 25 July, 14:00–15:00 • People's History Museum

See details for X361.

Imperial War Museum North tour: 'Saving Lives'

Event code: **X370**

Thu 25 July, 15:00–15:30 • Imperial War Museum North

See details for X354.

Imperial War Museum North tour: 'Saving Lives'

Event code: **X371**

Thu 25 July, 16:00–16:30 • Imperial War Museum North

On the edge of the Trafford Park industrial zone – a major target for bombers in the Second World War – the Imperial War Museum North opened in 2002. Its distinctive structure, designed by Daniel Libeskind, consists of shard-like projections, symbolising the fractures caused by conflict; its displays address the effects of war on the lives of service personnel and civilians around the world.

This guided tour explores **Saving Lives: Frontline Medicine in a Century of Conflict**, a major temporary exhibition exploring the interrelation of warfare and medicine from the First World War to the present. Learn about Major Margaret Barclay-Cooke, a nursing officer with the Queen Alexandra's Royal Army Nursing Corps, who, faced with sub-zero temperatures and basic conditions, transformed a disused operating theatre to treat patients in the immediate aftermath the

Falklands War. Find out about the production and distribution of penicillin at ICI in Trafford Park, in the Second World War and about Archibald McIndoe, pioneer of surgical reconstruction methods, whose whose RAF patients became known as the 'Guinea Pig Club'.

There is no charge for this tour. Please email tours@ichstm2013.com giving your name and the date and time of the tour.

Numbers will be limited to 20 people per tour. Please arrange your own travel to the Imperial War Museum North.

For more information about the exhibition, please see the website at www.iwm.org.uk/exhibitions/iwm-north/saving-lives or follow [@I_W_M](https://twitter.com/I_W_M) on Twitter.

Manchester Museum tour

Event code: **M372**

Thu 25 July, 12:00–13:00 • Manchester Museum

See details for M351.

Manchester Museum tour

Event code: **M373**

Thu 25 July, 13:00–14:00 • Manchester Museum

See details for M351.

Manchester Museum herbarium tour

Event code: **M374**

Thu 25 July, 13:00–14:00 • Manchester Museum

See details for M357.

Godlee Observatory visit

Event code: **X375**

Thu 25 July, late morning until early afternoon • Godlee Observatory

The Godlee Observatory within the former Technical School (now the University of Manchester's Sackville Street Building) was presented to the City of Manchester in 1903 by Francis Godlee. Its double telescopes, made by Grubb of Dublin, have been in regular use since that time, and the Observatory layout – including a library, distinctive spiral staircase, and an almost unique papier-mâché dome – is largely unchanged. The tower which houses the observatory and dome is a well-know landmark to commuters using the nearby Piccadilly Railway Station.

The Observatory is the home of Manchester Astronomical Society, whose members will provide tours for small groups during the Congress.

The Observatory will be open between 11.00 and 17.00. As the space is small, however, visitors will be taken up to the interior in small groups. Please sign up at the Congress Events Desk in advance to confirm a visiting time.

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There is no charge for this tour. Please arrange your own travel to the Sackville Street Building.

For more information about the Observatory and Manchester Astronomical Society, see the website at www.manastro.org.

Working Class Movement Library tour

Event code: **X376**

Fri 26 July, 12:00–13:00 • Working Class Movement Library

The Working Class Movement Library in Salford records over 200 years of organising and campaigning by ordinary men and women. This guided tour will discuss its extensive holdings on the growth of trade unions, socialist and co-operative organisations. The early Owenites and Socialists had a thirst for a wide education, including science and technology.

Visitors will also be able to see the exhibition developed to coincide with the Congress, showing the development of public and occupational health and campaigns to improve working conditions. The exhibition will also look at the role of scientists in the socialist and peace movements, featuring subjects including naturalist Alfred Russel Wallace in the year of the centenary of his death.

There is no charge for this walk. Numbers will be limited to 10 people per tour, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the Congress Events Desk. Please arrange your own transport to the Working Class Movement Library.

Victorian street tour at Salford Museum and Art Gallery

Event code: **X377**

Fri 26 July, 14:00–15:00 • Salford Museum and Art Gallery

As part of the Congress, Salford Museum and Art Gallery is offering a guided tour of Lark Hill Place, the Museum's famous re-creation of a Victorian street. Visitors will find out about the Victorian 'Chemist and Druggist' John Hamer and some of the remedies and contraptions on sale in his shop. For residents who preferred more 'traditional' medicine, there was always 'Mrs Driver, bleeder with leeches', whose work is described along with some of the home remedies that housewives might have cooked up.

There is no charge for this tour. Numbers will be limited to 35 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the Congress Events Desk. Please arrange your own transport to Salford.

For more information about Lark Hill Place, see the website at www.salfordcommunityleisure.co.uk/culture/salford-museum-and-art-gallery/lark-hill-place, or follow @Culture_SC on Twitter.

People's History Museum tour

Event code: **X378**

Fri 26 July, 14:00–15:00 • People's History Museum

See details for X361.

Imperial War Museum North tour: 'Saving Lives'

Event code: **X379**

Fri 26 July, 15:00–15:30 • Imperial War Museum North

See details for X354.

Manchester Museum tour

Event code: **M380**

Fri 26 July, 12:00–13:00 • Manchester Museum

See details for M351.

Manchester Museum tour

Event code: **M381**

Fri 26 July, 13:00–14:00 • Manchester Museum

See details for M351.

Imperial War Museum North tour: 'Saving Lives'

Event code: **X382**

Sat 27 July, 15:00–Thu 25 July, 15:30 • Imperial War Museum North

See details for X354.

A smellwalk of Manchester: can you smell Chinatown from here?

Event code: **X383**

Wed 24 July, 14:00–16:00 • Manchester Museum

What better way to experience Manchester's rich environmental history than to discover its olfactory side!

Join us for an exploration of the smells of Manchester's streets, squares, neighbourhoods and waterways on an organised guided tour led by Dr Victoria Henshaw from the University of Manchester's *famous Smell and the City* project.

Not to be sniffed at, the walk will combine both a smell experience of the city with information on the changing nature of urban smellscape over time and is guaranteed to tantalise your nostrils, tickle your trigeminal nerve and fire your olfactory imagination. Smells and maps will be provided.

Dr Victoria Henshaw is a researcher and lecturer in the Manchester Architecture Research Centre, University of Manchester. Her work focuses upon the role of the senses, and in particular smell, in experiences, perceptions and the design of the city. Her book, *Urban Smellscapes*, will be published by Routledge in September 2013. Her research has featured widely in electronic and broadcast media around the world including the UK, mainland Europe, America, Canada, Australia, New Zealand and Japan. See her conducting a [recent Smell Walk in Barcelona](#) here.

There is no charge for this walk, but numbers are limited: please reserve your place in advance by emailing Dr Vlad Janković, vladimir.jankovic@manchester.ac.uk, with the subject line 'smellwalk'.

Please wear comfortable walking shoes and remember to dress for the weather.

For more information about the Smell and the City project, please see the website at smellandthecity.wordpress.com.

A short walk about Turing

Event code: **M384**

Mon 22 July, 13:00–13:45 • Manchester Museum

Organiser: James SUMNER | University of Manchester, United Kingdom

Alan Turing (1912–1954) was appointed to the University of Manchester in 1948. In his earlier career, he had made crucial – though often overlooked – contributions to both the conceptualisation and the engineering of computing machines. Manchester, however, already had a well-developed computer design project: Turing's interests had moved on, to questions of how the new machines could be used, and what their existence might imply for human society. His wide-ranging and interdisciplinary Manchester work is best remembered for two strands: the iconic 1950 *Mind* article, which posed the question, 'Can machines think?'; and investigations of how computers might be used to model morphogenesis, the development of shape and form in biology.

Though the scope of these ideas was vast, the physical site of their development was notably small. Around 1950, most of the University was still confined to the immediate vicinity of the original Owens College buildings, on the west side of Oxford Road. This very short walk (with longer explanations) includes visits to two of the buildings where Turing worked, and aims to give a flavour of the geographies of interdisciplinary collaboration practiced in Turing's time.

The walk will be led by Dr James Sumner of the University's Centre for the History of Science, Technology and Medicine.

There is no charge for this walk. Numbers will be limited to 20 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the Congress Events Desk.

Those attending may also be interested in the **Turing Machine Opera** event at the Capitol Theatre on **Monday** and **Tuesday** evenings.

National Railway Museum tour in York

Event code: **X385**

Thu 25 July, 14:30–16:30 • National Railway Museum, York

The National Railway Museum holds Britain's largest single collection of historic railway material. It has its origins in the collections assembled by railway companies in the mid nineteenth century, and in the rich body of material accumulated by the Science Museum. The Museum opened in York in 1975 and has continued to develop the collections to cover all areas of railway history, encompassing a wide variety of material from unique icons to everyday objects, revealing the importance of railways and their impact on the human and physical environment.

This tour will take you behind the scenes into the Museum Workshop, where our team of engineers and conservators help to maintain the collections in good condition and into Search Engine to see how former railway offices and workshops have been converted into high-grade controlled storage for over 300 archive collections and 22 000 books, see how the NRM stores and manages its massive photographic, poster and art collections, and see some of the treasures from the NRM's archive collections, including eye-witness accounts from the opening of the Stockton & Darlington Railway and the Rainhill Trials, rare Bradshaw's timetables, intricate engineering drawings, historic tickets, and much more.

There is no charge for this tour. Numbers will be limited to 25 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the Congress Events Desk.

You will need to arrange your own travel to York. A regular direct rail service operates from Manchester Oxford Road and Piccadilly Stations.

For more information, see the website: www.nrm.org.uk/

Chetham's Library tour

Event code: **X386**

Thu 25 July, 14:00–15:30 • Chetham's Library

Chetham's Library was founded in 1653, and is the oldest public library in the English-speaking world. It is housed in one of Manchester's oldest buildings, the former College of Manchester which dates from the 1420s. The Library has been used by Karl Marx and Friedrich Engels, John Wesley, Daniel Defoe, Benjamin Franklin and John Dalton. The Library began acquiring books in August 1655, and has been adding to its collections ever since. In the seventeenth century Chetham's acquired large numbers of scientific books, and has early editions of some of the most important scientific books ever published. Delegates will be given a tour of the medieval building before a handling session where some of the library treasures will be on view.

There is no charge for this tour. Numbers will be limited to 20 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the Congress Events Desk. Please arrange your own travel to Chetham's.

For more information, see the website: www.chethams.org.uk/

National Media Museum tour in Bradford

Event code: **X387**

Thu 25 July, 14:30–16:00 • National Media Museum, Bradford

Situated right in the heart of Bradford, UNESCO City of Film, the National Media Museum exists to promote an appreciation and

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understanding of media through nine floors of galleries, an extensive collection and research facility, and three cinemas including the UK's first IMAX theatre. The collection includes the National Photography Collection, the National Cinematography Collection, the National Television Collection, and the National New Media Collection. The curator-led tour will take you around the museum and stores.

There is no charge for this tour. Numbers will be limited to 12 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

You will need to arrange your own travel to Bradford. A regular direct rail service operates from Manchester Victoria Station.

For more information, see the website:
www.nationalmediamuseum.org.uk

University of Manchester Museum of Medicine and Health collections

Event code: **M387**

Thu 25 July, 14:00–16:00

The Museum of Medicine and Health contains a vast and diverse array of artefacts and archives dating from the seventeenth to the twentieth century which supports and illustrates our understanding of the history of medicine, health and disease. The Museum collects and conserves artefacts and archives relevant to the discipline and practice of medicine and health and is used as a teaching and research resource for members of staff, students and the public. We offer a programme of talks in which historians or practitioners talk about the significance of an object in our collection. Recently we have assisted the Medical Research Council and the Museum of Science and Industry with exhibitions.

The Museum does not currently have permanent display space so our open afternoon is an opportunity for interested delegates to view our collection. If there are specific artefacts or archives which you are interested in viewing then let us know in advance. Alternatively, please feel free to just come and have a browse. Copies of the Museum catalogue can be obtained from Katherine Andrews, Museum Assistant, at katherine.andrews@manchester.ac.uk.

If you would like to visit, please email Katherine at the above address to arrange this. We look forward to seeing you.

For more information, see the website:
www.manchester.ac.uk/mms/museum

John Dalton walk

Event code: **X388**

Tue 23 July, 13:30–15:30 ▪ Visitor Information Centre, Piccadilly Gardens

John Dalton was born in the Lake District in 1766 and came to Manchester to teach maths at the Academy which stood where the Peace Garden can be found. He lived at various addresses nearby, in what is now Chinatown.

Dalton conducted experiments with gases at the Literary and Philosophical Society's rooms in George Street (the last of Ford Madox Brown's murals in the Town Hall depicts him and his assistant gathering marsh gas in a pond in Old Trafford), and there devised his ground-breaking atomic theory. But what was the practical application?

In Manchester, within a generation, cotton merchants were creating new cloths dyed with colours formed using Dalton's calculations – cloth that didn't run in the wash, and helped Manchester secure its place as the world centre for cotton production and manufacture. Dalton also devised new theories about the weather and colourblindness, the word for which, in some European languages, uses his name.

On the John Dalton walk, we explore the man behind the maths and molecules, recalling his haunts and habitats around Manchester.

There is no charge for this walk. Numbers will be limited to 20 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

Please arrange your own travel to the Visitor Information Centre.

Cottonopolis walk

Event code: **X389**

Tue 23 July, 11:00–13:00 ▪ Visitor Information Centre, Piccadilly Gardens

Manchester was Cottonopolis. The Industrial Revolution changed lives, and changed the face of a sleepy northern town forever. Why Manchester, and what were the consequences of this upheaval?

On our walk along the streets built by the cotton trade, we will see how the city centre was transformed in the nineteenth century because of the riches made when Manchester clothed the world. The Cotton Exchange, cotton warehouses, weavers' cottages, a library fit for a prince, and commercial buildings fit to oversee an empire will all feature as we stroll through the city centre. The wealth of cotton made Manchester the shock city of its day. The industry that made us has come and gone, but Manchester is built on the bones of cotton.

There is no charge for this walk. Numbers will be limited to 25 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

Please arrange your own travel to the Visitor Information Centre.

Modernist Manchester walk

Event code: **X390**

Thu 25 July, 13:00–15:30 • University Place

The Manchester Modernist Society will lead you through a short condensed history of Manchester – the Original Modern City.

Manchester is a city in constant flux and it has never been one to shy away from embracing new ideas and new technologies. On this short walk, **Eddy Rhead** of the Manchester Modernist Society will attempt to show how new ideas have shaped Manchester but also how Manchester has been at the forefront of shaping some ideas of its own. We will look at architecture and buildings from all periods, and see how Manchester has evolved from being the dirty, grimy fulcrum of the Industrial Revolution by passing through the 'White Heat of Technology' and beyond.

There is no charge for this walk. Numbers will be limited to 25 people, so please register in advance. You can do this at any time before the Congress by emailing tours@ichstm2013.com with your details; or you can sign up in person at the [Congress Events Desk](#).

For more information, see the website:
www.manchestermmodernistsociety.org

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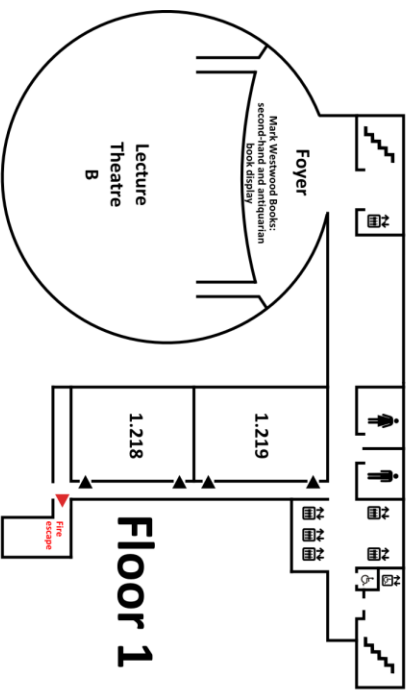
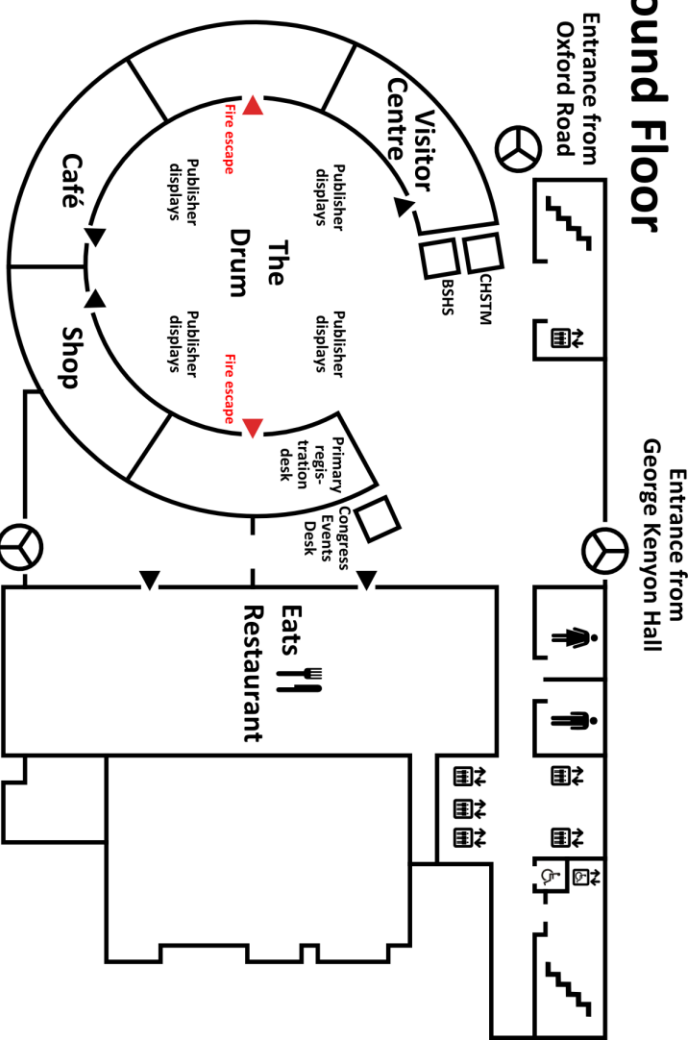
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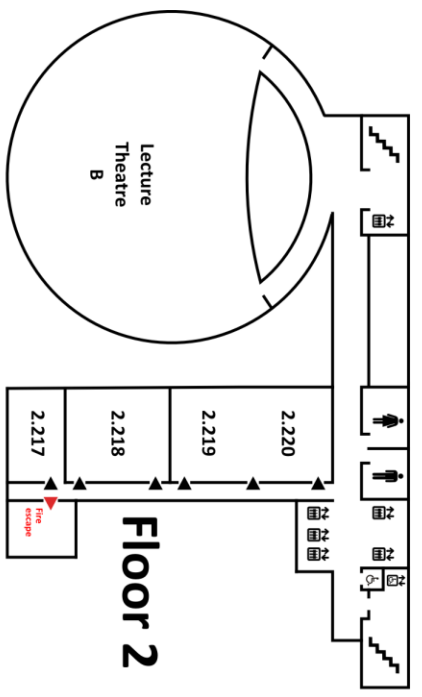
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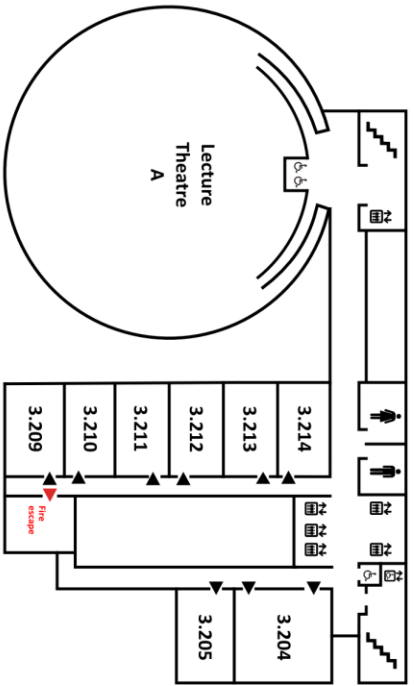
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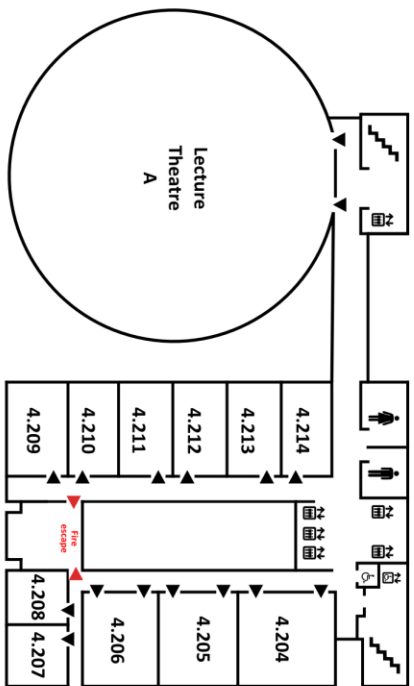
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Floor 3



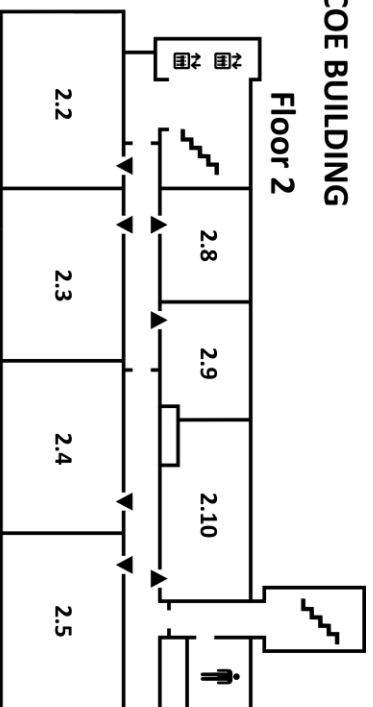
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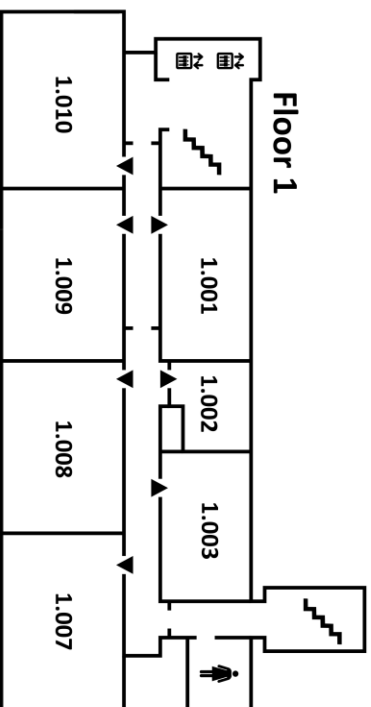
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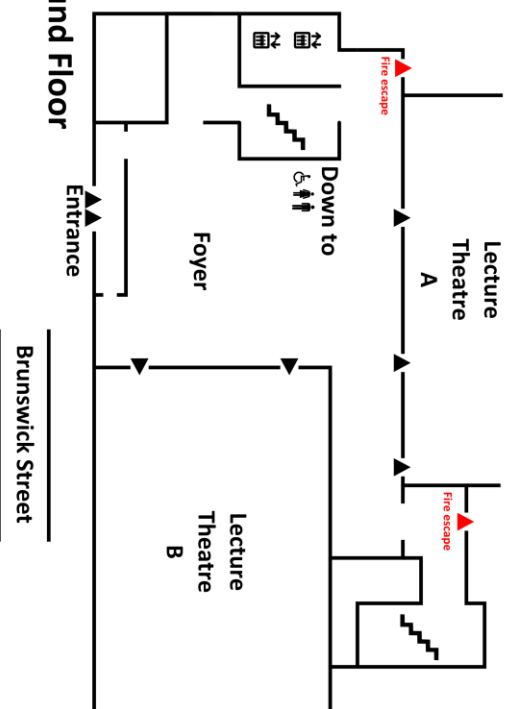
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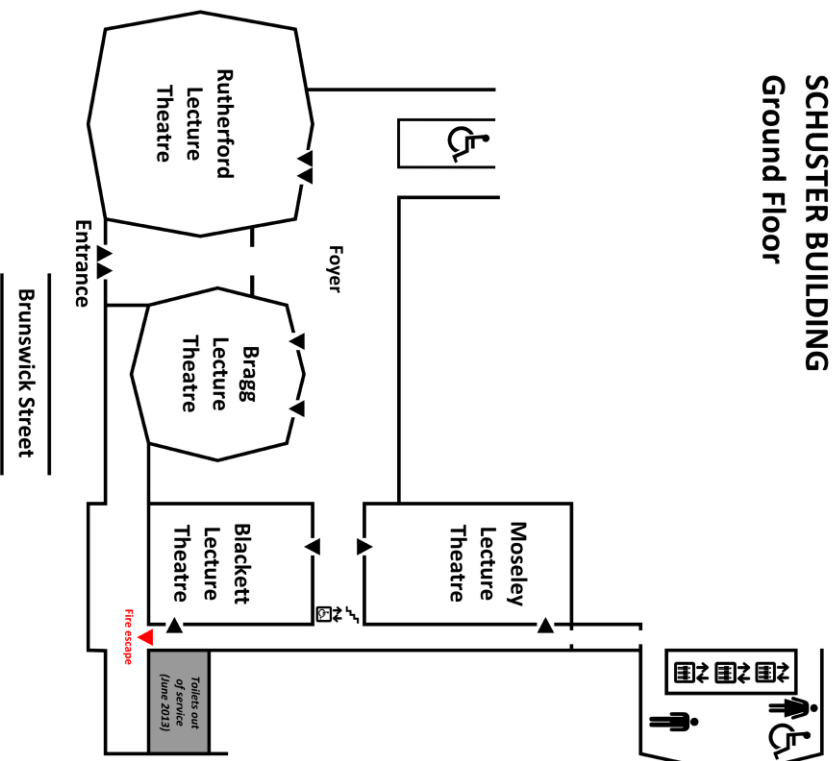


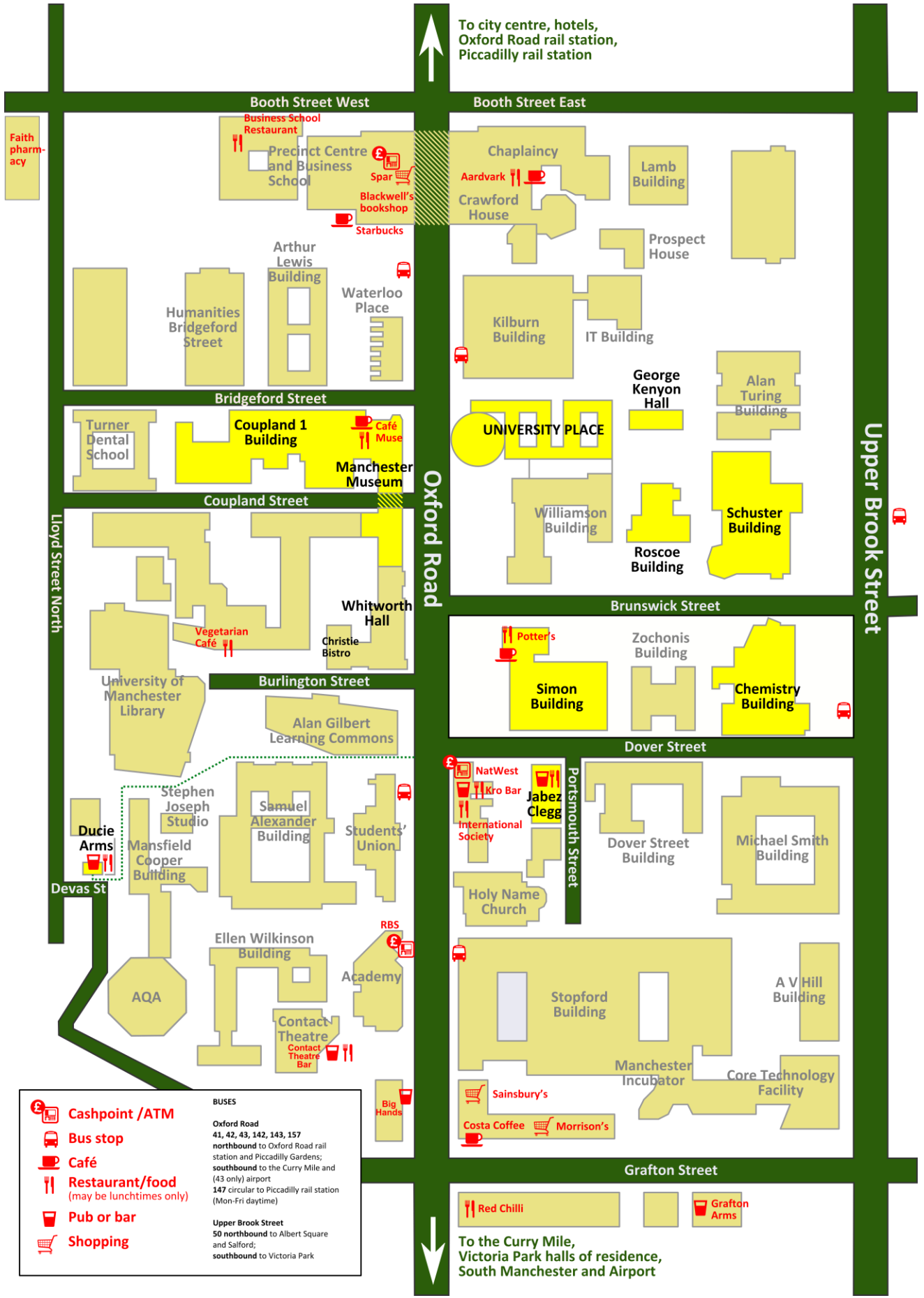
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