

JOINT MEETING

BRITISH SOCIETY FOR THE HISTORY OF SCIENCE

**CANADIAN SOCIETY FOR THE
HISTORY AND PHILOSOPHY OF SCIENCE**

HISTORY OF SCIENCE SOCIETY

3-5 AUGUST 2000
ST. LOUIS, MISSOURI
HYATT UNION STATION

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A word on the cover design:

The program cover for the 2000 meeting of the British-North American conference was designed by Matthew Sneddon using Adobe Photoshop. We gratefully acknowledge the St. Louis Convention & Visitors Convention for providing the photograph used in the cover design.

A GUIDE TO ST. LOUIS

St. Louis is a very hospitable city with a lot more going on than may meet the eye at first glance. Local sites, all in close proximity to Union Station (and walkable if you are energetic), to see include:

ANHEUSER-BUSCH BREWERY: Located in South St. Louis (off highway I-55), not really walkable. During the day, they offer guided tours with “samples” of beer at the end.

GATEWAY ARCH (National Monument): Good museums and interpretive center along with rides to the top of the arch itself. Next to the Arch, on the south, is the Old Cathedral. Built about 1830, the Cathedral looks like a New England rather than a western colonial structure.

CAHOKIA MOUNDS STATE PARK (Illinois): The Visitors’ Center here is quite well done and very informative. Cahokia was one of the largest native American settlements in North America until it disappeared in the 12th or 13th centuries. Monks Mound is one of the largest terraced mounds anywhere.

LACLEDE’S LANDING: An old riverfront area that has been restored with cobblestone streets, the levees, etc. Good restaurants, but just fun to walk around and get some feel for what St. Louis was like when, in the period 1810-1850 it was something like the fourth largest city in the country. Laclede’s Landing is just north (upstream) of the Arch, so people could visit both in one day.

HISTORIC NEIGHBORHOODS (Listed from east to west):

SOULARD MARKET AND HISTORIC DISTRICT: Just south and east of Union Station this area has a famous Farmer’s Market nestled in an extensively restored area of houses built between 1820 and 1900.

LAFAYETTE SQUARE HISTORIC DISTRICT: Due south of Union Station along 18th St., this mid-century/Victorian neighborhood is centered around Lafayette Park, the oldest park west of the Mississippi (laid out in 1837). The neighborhood is almost completely restored and received the “Prettiest Neighborhood in the U.S.” award from Architectural Digest/Better Homes and Gardens for 1999. Six blocks away from Union Station, with several outstanding restaurants.

GRAND/SOUTH GRAND (One stop on Metrolink from Union Station going west, but still a good 8-10 block hike to the interesting areas): Get off Metrolink at the Grand Avenue stop and proceed past St. Louis University Hospitals (and Medical Area) to Tower Grove Park, a really beautiful 19th century German park well-maintained with quaint gazebos built between 1860 and 1880. Good walking in the park. On further south are a number of good ethnic restaurants, including Asian.

CENTRAL WEST END: West of downtown, about half-way to the western edge of the city. Take Metrolink and get off at the Central West End/Washington University Medical Center/Narnes-Jewish Hospital stop. Go north from the medical area, across Lindell Blvd, for great shops, restaurants, sidewalk cafes, and beautiful homes.

THE HILL: A south-side Italian neighborhood with many outstanding Italian restaurants. You would need a car/taxi to get there. Not far from the Missouri Botanical Garden. If you like Italian food this is one of the places to visit.

FOREST PARK: One of the largest urban parks in the country, Forest Park was the site of the 1904 World's Fair (and setting for much of the Judy Garland movie, "Meet Me in St. Louis"). The St. Louis Art Museum and History Museum, as well as the outstanding St. Louis Zoo (home for Marlin Perkins and "Zoo Parade" in the 1960s-70s) are all located there. Take Metrolink to the Forest Park Stop and either walk from there to the History Museum (2 short blocks) and the Art Museum (visible from the History Museum, but across a golf course and a bit of a walk). There is also a Forest Park shuttle you can take from the Metrolink stop to various sites in the park.

HISTORIC HOUSES/MUSEUMS:

St. Louis is an old city with many of its historic structures still intact. Several sites that might be of interest and that are accessible from Union Station are:

DEMENIL MANSION AND RESTAURANT (3352 DeMenil Place): A mid-19th century mansion meticulously restored, near Anheuser-Busch brewery; has a good restaurant (for lunch) attached. Small admission charge. Take a taxi or car.

CAMPBELL HOUSE MUSEUM (1508 Locust): An 1850s townhouse, one of the few still surviving in the heart of downtown; walkable from Union Station (north)

EUGENE FIELD HOUSE AND ST. LOUIS TOY MUSEUM (634 South Broadway): Home of 19th century children's writer Eugene Field ("Little Boy Blue," "Wynken, Blynken and Nod"); well-restored and includes a large collection of 19th century toys, especially dolls.

TOWER GROVE HOUSE (Missouri Botanical Garden): Country home of Henry Shaw, who gave his estate to form the Garden; the house has been meticulously maintained since the 1850s. Worth seeing on a trip to the Garden

RESTAURANTS:

Mostly within walking distance of Union Station, but so indicated if further away:

AL'S RESTAURANT (1200 N. First St, North of Laclede's Landing): One of St. Louis' premiere restaurants specializing in steaks, pork chops and sea food. Pricey — a whole evening's worth of dining.

AMAGHETTI'S DOWNTOWN (711 Olive St.): A superb Italian sandwich, pasta and soup restaurant. Not too expensive.

ARCELIA'S MEXICAN RESTAURANT (2001 Park Ave, in Lafayette Square): Only 6 blocks from Union Station; excellent Mexican food and reasonable prices. Highly recommended.

BALABAN'S RESTAURANT (405 N. Euclid Ave, in the Central West End): An outstanding restaurant accessible by Metrolink (see above). A bit pricey but worth it.

BARTOLINO'S RESTAURANT (2524 Hampton Ave): On the edge of "The Hill"; a great restaurant moderately priced. They have a set of house specials that include soup, salad, entree and spumoni for under \$18.00. Would need a car or taxi to get there.

BROADWAY OYSTER BAR (736 South Broadway): A doable hike from Union Station. Its name is descriptive, a great raw bar with all sorts of other items as well, specializing in Cajun-Creole.

BRUNO'S LITTLE ITALY (5901 Southwest Ave): On "The Hill"; an outstanding Italian restaurant, very expensive and slow, leisurely dining. Worth it for a relaxing evening. Car or taxi needed.

C. WHITTAKER'S BISTRO (238 North Euclid, Central West End). Good food and moderately expensive.

CAFE DE FRANCE (410 Olive): Downtown and walkable; outstanding French food, but expensive.

CALECO'S RESTAURANTS AND BARS (101 North Broadway): Downtown, walkable and a good Italian chain. Moderately priced, but not as good as some of the specialty Italian places on "The Hill."

CLEMENTINE'S BAR AND GRILL (2001 Menard): In Soulard historic neighborhood, attached to a leather-oriented gay bar (not for the faint of heart), but great food (prime rib, seafood) at very reasonable prices. Safe area but car or taxi is recommended.

CULPEPPER'S (300 North Euclid, Central West End): Great (and Hot) wings, salads and other lighter dishes. Good for lunch.

FAUST'S RESTAURANT (4th and Chestnut in the Adams Mark Hotel): Expensive, but outstanding food and service.

GRAZIER'S TRAVELING BROWN BAG RESTAURANT (1811 Pestalozzi Ave): South St. Louis near Anheuser-Busch Brewery. Name is misleading, as it is a full-fare restaurant; good food but busy, especially on weekends.

HARRY'S RESTAURANT AND BAR (2144 Market, just 3 blocks west of Union Station): Good food; mostly U.S. cuisine and a bit pricey, but worth it.

HOT LOCUST (2005 Locust St): Excellent southwestern fare, reasonably priced. About 8-10 blocks walk north from Union Station. Recommend you take a taxi.

KING AND I (3157 South Grand): Thai food, very popular and not too expensive. Metrolink access with hefty walk from the Grand Avenue stop. Use a cab.

LORENZO'S TRATTORIA (1933 Edwards Ave): On "The Hill"; considered one of the best small Italian restaurants. Requires car or cab. Not too expensive.

LYNCH STREET BISTRO (1031 Lynch St): Near Anheuser-Busch Brewery, serves southwestern and other "nouvelle" fare; pricey, but fun. Car or taxi.

MORGAN STREET BREWERY (721 North 2nd St): Walkable from Union Station, a microbrewery, comes well recommended.

NORTON'S CAFE (808 Geyer Ave): South St. Louis, near Anheuser-Busch Brewery. Specializes in Cajun-Creole, with an outstanding reputation; medium to expensive, but well worth it.

RICARDO'S ITALIAN CAFE (1931 Park Ave): In Lafayette Square, an outstanding Italian restaurant with all sorts of variety. Reasonable prices.

ST. LOUIS STEAKHOUSE (101 South 11th St): Downtown and walkable, with typical U.S. Midwestern fare. Pretty expensive but big portions.

TAP ROOM AND ST. LOUIS BREWERY (2100 Locust): A microbrewery (Schlafley Beer) with excellent food. Reasonably priced, with sample beer trays with your meal. A little noisy.

TONY'S OF ST. LOUIS (410 Market): Close to Union Station, a much-touted and awarded restaurant. Good food but very expensive and a little pretentious, but definitely a good night out for dining.

TUCKER'S PLACE (2117 South 12th): In Soulard Historic Neighborhood, about 10 blocks south of Union Station. A pub with good but standard food, great atmosphere. Safe area, but recommend car or taxi.

On weekends most of these restaurants take reservations, which are highly recommended.

ACKNOWLEDGMENTS

Dozens of individuals have lent their energy and time to the creation of this fourth meeting. Not all of them can be named—although their efforts are no less appreciated—but I would like to recognize some of the many who spent countless hours on this important conference. Our three program chairs, Jon Agar, Bernie Lightman, and Paul Theerman, began their labor on this program in the Fall of 1998. Since that time they have answered, swiftly and with grace, thousands of questions concerning the fourth quadrennial meeting. I consider myself inordinately fortunate to have been able to call on their collective wisdom. Others who were part of the early deliberations surrounding the St. Louis meeting included Fred Gregory, Al Van Helden, and Liba Taub of the HSS and Steve Pumfrey and Geoff Bennett of the BSHS. Their help and guidance were welcome at every step. Gar Allen provided assistance with local arrangements, as did Jane Miller and Paul Roth. The HSS Executive Committee—Ron Numbers, John Servos, Margaret Rossiter, Marc Rothenberg, and Keith Benson—provided much needed support, as did Lesley Cormack and Ludmilla Jordanova of the CSHPS and the BSHS, respectively. The meeting mechanics, from issuing the call for papers to ensuring that name badges were printed, were handled in marvelous fashion by the HSS Executive Office staff. My deepest thanks to each of them for their unfailing humor: Melissa Oliver, Gail Alexander, Carson Burrington, and Matthew Sneddon.

Jay Malone
HSS Executive Director

BSHS, CSHPS, AND HSS OFFICERS PROGRAM CHAIRS

BSHS EXECUTIVE COMMITTEE

Jim Bennett, President
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Ludmilla Jordanova, Vice-President
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University of Washington

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Robert J. Malone, Executive Director
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PROGRAM CHAIRS

Jon Agar
University of Manchester

Bernard Lightman
York University

Paul Theerman
NLM/Digital Manuscripts Program

2000 LOCAL ARRANGEMENTS CHAIR

Garland Allen
Washington University, St. Louis

BOOK EXHIBIT

The book exhibit is located in Foyer C, adjacent to the meeting registration desk.
Hours: 8:00 a.m. to 5:00 p.m., Friday, 4 August and Saturday, 5 August.

EXHIBITORS WITH REPRESENTATIVES

MIT Press
The University of Chicago Press

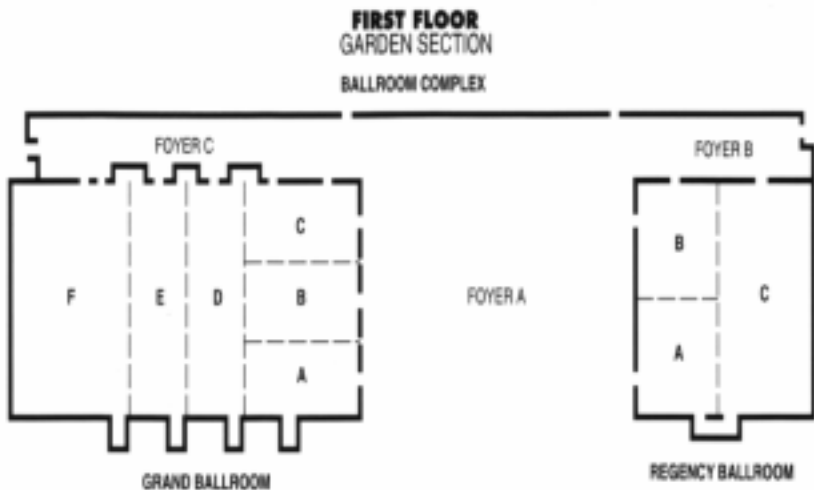
The Scholar's Choice

EXHIBITORS WITHOUT REPRESENTATIVES

Ashgate
Columbia University Press
Kluwer Academic Press
Taylor and Francis
University Press of New England

Birkhauser Boston
Kent State University Press
Oxford University Press
University of Nebraska Press
World Scientific Publishing

HYATT REGENCY ST. LOUIS AT UNION STATION MEETING ROOM FACILITIES



KEYNOTE ADDRESS

TALL TALES AND SHORT STORIES: NARRATING THE HISTORY OF SCIENCE



(PHOTO CREDIT: RON BERGERON)

JAN GOLINSKI
UNIVERSITY OF NEW HAMPSHIRE

THURSDAY, 3 AUGUST
6:00 - 7:00 P.M.
GRAND BALLROOM F

PROGRAM SCHEDULE

THURSDAY, 3 AUGUST

REGISTRATION

2:00 - 6:00 P.M.

FOYER A

KEYNOTE ADDRESS

6:00 - 7:00 P.M.

TALL TALES AND SHORT STORIES: NARRATING THE HISTORY OF SCIENCE

Jan Golinski, University of New Hampshire

GRAND BALLROOM F

RECEPTION

7:00 - 8:00 P.M.

GRAND HALL

FRIDAY, 4 AUGUST

REGISTRATION

8:00 A.M. - 5:00 P.M.

FOYER A

BOOK EXHIBIT

8:00 A.M. - 5:00 P.M.

FOYER C

9:00-11:45 A.M.

*Denotes Session Organizer & Special Millennial Sessions

RECONSIDERING MATHEMATICAL PRACTITIONERS IN THE 16TH AND 17TH CENTURIES

GRAND BALLROOM A

***Steven A. Walton**, *University of Toronto*, Thomas Hood and Armada Angst: How Mathematical Were the Military Sciences?

Hester K. Higton, *University of Exeter*, Does Using an Instrument Make you Mathematical? 'Mathematical Practitioners' of the 17th Century, and Their Instruments

Katherine L. Neal, *University of Sydney* and **John A. Schuster**, *University of New South Wales*, Practical Mathematics and Narratives of the Scientific Revolution: What Ever is to be Done?

Commentator and Chair: Lesley B. Cormack, University of Alberta

ALCHEMY IN OLD EGYPT

GRAND BALLROOM B

***Hamed A. Ead**, *Cairo University*, Earliest Chemical Manuscripts of the Chemical Arts in Egypt

Ibrahim Yaseen, *Mansoura University*, Sources of Science: “Egyptian Origins”

Maher Aly, *Alexandria University*, Medical School Traditions in Ancient Egypt

Commentator and Chair: Hamed A. Ead, Cairo University

SCIENTIFIC WAYS OF SEEING: A RE-VISION*

GRAND BALLROOM C

Anke te Heesen, *Max-Planck-Institut für Wissenschaftsgeschichte*, Closed and Transparent Orders: How the Furniture of Collections was Seen in the Enlightenment

***Emma Spary**, *Max-Planck-Institut für Wissenschaftsgeschichte*, By Design: Shell Prints and an ‘Aesthetics’ of Scientific Illustration in 18th-Century Europe

Anne Secord, *University of Cambridge*, Botany on a Plate: The Role of Illustration in Dishing up Knowledge

Commentator and Chair: Ludmilla Jordanova, University of East Anglia

THE LEGACY OF THOMAS KUHN: REFLECTIONS ON FULLER’S *THOMAS KUHN: A PHILOSOPHICAL HISTORY FOR OUR TIMES**

GRAND BALLROOM D

Jeff Hughes, *University of Manchester*

Jan Golinski, *University of New Hampshire*

Philip Mirowski, *University of Notre Dame*

Paul Roth, *University of Missouri, St. Louis*

Commentator: *Steve W. Fuller, University of Warwick

Chair: Paul Roth, University of Missouri, St. Louis

RETHINKING “PROFESSIONALISATION” IN VICTORIAN SCIENCE

GRAND BALLROOM E

Ruth Barton, *University of Auckland*, “Men of Science”: Language, Identity and the Professionalization of British Science, 1850-1880

Jim Endersby, *University of Cambridge*, Putting Plants in their Place: Joseph Hooker and the Making of Amateurs

Ben Marsden, *University of Aberdeen*, The Professional and Professorial: Engineering under Cover in the Early Victorian Universities

Commentator and Chair: Sophie Forgan, University of Teesside

THE HISTORY OF SCIENCE IN NATIONAL CONTEXT

REGENCY B

Klaas van Berkel, *University of Groningen*, The Netherlands and Belgium

Stuart W. Leslie, *Johns Hopkins University*, and **Ronald L. Numbers**, *University of Wisconsin, Madison*, The United States

Roderick W. Home, *University of Melbourne*, Australia and New Zealand

Commentator: Marc Rothenberg, Smithsonian Institution

Chair: Bernard Lightman, York University

FRIDAY, 4 AUGUST

1:30-3:10 P.M.

*Denotes Session Organizer & Special Millennial Sessions

MATHEMATICS AND ART IN THE SCIENTIFIC REVOLUTION

GRAND BALLROOM A

Scott L. Montgomery, *Independent Scholar*, Needed Revision in the History of Science and Art: The Case of Jan Van Eyck

Renzo Baldasso, *University of Oklahoma*, Galileo's *Dialogo* and Scheiner's *Rosa Ursina*

Katherine L. Neal, *University of Sydney*, A Tale of Two Teachers: Success and Failure in Early Modern Mathematics

Chair: Wilbur Applebaum, Illinois Institute of Technology

SCIENCE AND RELIGION

GRAND BALLROOM B

Russell M. Lawson, *Oklahoma School of Science and Mathematics*, The Pious Scientist: Jeremy Belknap, the New Science, and Christianity

Sujit P. Sivasundaram, *University of Cambridge*, Probing Bounds: Collection, Natural History, Missionaries and Pacific Islanders

Susantha Goonatilake, *New School for Social Research*, South Asian Philosophical Resonances and the New Physics: Influence or Resonance?

Chair: Margaret C. Jacob, University of California, Los Angeles

SCIENCE IN THE NINETEENTH-CENTURY PERIODICAL: DEMONSTRATION OF SCIPER DATABASE / NLM/DIGITAL MANUSCRIPTS PROGRAM

GRAND BALLROOM C

***Geoffrey N. Cantor**, *University of Leeds*

Gowan Dawson, *University of Sheffield*

Jonathan R. Topham, *University of Leeds*

Paul Theerman, *National Library of Medicine*, Profiles in Science: Biomedical Research in the Twentieth Century

NINETEENTH-CENTURY SCIENCE

GRAND BALLROOM D

Michael P. White, *McGill University*, Modern Times: Temporality and Modernity in Charles Lyell's *Principles of Geology*

Elizabeth Garber, *SUNY, Stony Brook*, Why Mathematics?

Ellen Valle, *University of Turku*, A Collective Intelligence: Aspects of discourse in 18th and 19th-century writing in the life sciences

Chair: Robert J. Malone, History of Science Society

ETHICS, HUMANISM, AND THE HUMANITIES

GRAND BALLROOM E

Katharine Wright, *University of Toronto*, Humanism, Antihumanism, and Technoscience
Benjamin R. Cohen, *Virginia Tech*, On the Two Temperaments of Science and the Humanities: Those That Bridge the Divide and Those That Blur

Chair: TBA

FRIDAY, 4 AUGUST

3:30-5:30 P.M.

*Denotes Session Organizer & Special Millennial Sessions

SCIENCE, HEALTH AND THE STATE

GRAND BALLROOM A

Paul C. Chrostowski, *CPF Associates, Inc.*, Public Perception of the Evolution of the Dose-Response Relationship in Toxicology

Elizabeth A. Hachten, *University of Wisconsin, Whitewater*, Across the Revolutionary Divide: Epidemics, Science and the Russian State

Martin Lengwiler, *University of Zurich*, Welfare State and Risk Society: The Historical Dimension of Current Risk Debates

Ki-heung Kim, *University of Edinburgh*, Controversy on the Nature of the Scrapie Agent in the 1960s

Chair: Paul Theerman, National Library of Medicine

NATURAL HISTORY AND EVOLUTION

GRAND BALLROOM B

Tobias Cheung, *University of Tokyo*, Cuvier's Heritage: Living Architecture Between Natural Burdens and Regulative Devices

Gregory S. Goodale, *George Mason University*, The Early Evolution of Evolution Theory

Igor Yu. Popov, *St. Petersburg Branch of the Institute for the History of Natural Sciences*, Analysis of a Prototype of "Case Study"

Gregory M. Radick, *University of Cambridge*, Victorian Society in Darwin's Theory of Natural Selection

Chair: Robert J. Richards, University of Chicago

THE CONTEXT OF DISCOVERY

GRAND BALLROOM C

Lawrence S. Dritsas, *Virginia Polytechnic Institute and State University*, The Nile Sources: Rereading the Journals of Discovery

André R. LeBlanc, *Université du Québec à Montréal*, The Problem of Post-hypnotic Suggestion in France, 1884-1896

David A. Steinberg, *Saa Institute*, Concomitance and Complementarity—Common Paths to a Modern Science

Rhona G. Leibel, *Metropolitan State University*, Epistemic Disunity in the Study of International Relations: Assessing Interwar Idealism

Chair: Elizabeth Green Musselman, Southwestern University

READING “BOOKS OF NATURE”: NEW DIRECTIONS IN SCIENCE AND RELIGION*

GRAND BALLROOM D

Jonathan R. Topham, *University of Leeds*, Religious Practices and the Uses of Scientific Books

Peter Denton, *University of Winnipeg*, Framing the Discourse: Science, Religion and the Hermeneutics of ‘the Book’

Geoffrey N. Cantor, *University of Leeds*, Rhetorics of Concord and Dissonance
Commentator and Chair: David B. Wilson, Iowa State University

HISTORY AND PHILOSOPHY OF SCIENCE: STATE OF THE RELATIONSHIP*

GRAND BALLROOM E

***Gary Hatfield**, *University of Pennsylvania*, History and Philosophy of Science: On Telling the Players

Don Howard, *University of Notre Dame*, Kith or Kin? On the Relationship between History and Philosophy of Science

Commentator: R. Steven Turner, University of New Brunswick

Chair: Heinrich von Staden, Princeton University

SATURDAY, 5 AUGUST

REGISTRATION

8:00 A.M. - 5:00 P.M.

FOYER A

Book Exhibit

8:00 A.M. - 5:00 P.M.

FOYER C

SATURDAY, 5 AUGUST

9:00-11:45 A.M.

**Denotes Session Organizer & Special Millennial Sessions*

NEWTON’S PRINCIPIA: TRANSLATION AND REASSESSMENT

GRAND BALLROOM A

I. Bernard Cohen, *Harvard University*, Translating Newton’s *Principia*

William L. Harper, *University of Western Ontario*, Newton’s *Principia* as a Historical Introduction to Theory and Evidence

George Smith, *Tufts University*, Newton’s *Principia* in the Philosophy Curriculum

Michael Nauenberg, *University of California, Santa Cruz*, The Role of Curvature in Newton’s Dynamics

Chair: *J. Bruce Brackenridge, Lawrence University

VISUALISATION OF SCIENTIFIC ACTIVITY*

GRAND BALLROOM B

Ludmilla Jordanova, *University of East Anglia*, Visual Culture and Scientific Practice
Charlotte Klonek, *University of Warwick*, Artful Science: Natural History and its Images in Eighteenth-Century Europe

Deborah Jean Warner, *Smithsonian Institution*, “I never intend to wrap my Talent in a Napkin”: Benjamin Franklin as a Man of Achievement

***Frank A.J.L. James**, *Royal Institution*, Harriet Moore, Michael Faraday, and her Watercolours of the Interior of the Royal Institution

Chair: Jon Agar, University of Manchester

NEW DIRECTIONS IN THE HISTORY AND MATERIAL CULTURE OF EXPERIMENT*

GRAND BALLROOM C

John A. Schuster and **Alan B.H. Taylor**, *University of New South Wales*, Organising the ‘Experimental Life’ at the Early Royal Society: The Production & Communication of Experimentally Based Knowledge

Richard Sorrenson, *Indiana University*, Matter matters: Or How to Nullify the Peculiarities of the Material World

***Graeme J.N. Gooday**, *University of Leeds*, Tempering and Amalgamating the Boundaries: Characters and Metals in the History of Science and Technology

Falk Mueller, *Carl-von-Ossietzky University*, Experimental Spaces and Conceptual Development in 19th-Century Gas Discharge Physics

Commentator and Chair: Peter Heering, Carl-von-Ossietzky University

FOUNDING DISCIPLINES

GRAND BALLROOM D

Matthew R. Goodrum, *Indiana University*, Establishing a Place for the History of Prehistoric Anthropology and Archaeology within the History of Science

David P.D. Munns, *Johns Hopkins University*, Phytotrons: Where the Greenhouse Met the Cyclotron

Colin Russell, *The Open University*, Where Science Meets Technology: The Special Case of Chemistry?

Chair: David A. Steinberg, Saa Institute

THE EMOTIONAL ECONOMY OF SCIENCE: SYMPATHY AND THE FORMATION OF SCIENTIFIC COMMUNITIES, 1800-1930

GRAND BALLROOM E

Elizabeth Green Musselman, *Southwestern University*, Forging Community through Bodily Sympathy in Industrial-era Natural Philosophy

***Paul S. White**, *University of Cambridge*, Passion for Science: The Display of Feeling in Late-Victorian Biology and Medicine

Otniel E. Dror, *Hebrew University*, Purity and Danger: Sympathy, Antipathies, and the Boundaries of Science

Commentator and Chair: James A. Secord, University of Cambridge

SATURDAY, 5 AUGUST

1:30-3:10 P.M.

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POLITICAL COSMOLOGY

GRAND BALLROOM A

Elizabeth R. Neswald, *Humboldt Universitaet zu Berlin*, Cyclical Cosmologies in Late 19th-Century Germany

Daniel Gasman, *John Jay College, CUNY*, Ernst Haeckel in Italy: Monism and the Birth of Fascist Ideology

Paul T. Arpaia, *Baruch College*, Evolving into Italians: Evolutionism in Giosuè Carducci's Conception of Italian Cultural and Political Identity

Chair: Robert J. Malone, History of Science Society

HISTORY OF SCIENTIFIC INSTRUMENTATION

GRAND BALLROOM B

Sven Dupré, *University of Gent*, Instruments and Embodiment in Art and Science
Roland Wittje, *Norwegian University of Science and Technology*, Scientific Instruments as Source Material for History of Late 19th- and Early 20th-Century Physics

Chair: Marc Rothenberg, Smithsonian Institution

EIGHTEENTH-CENTURY STUDIES

GRAND BALLROOM C

Susan McMahon, *University of Alberta*, Inventing Botany at the Royal Society

Peter Heering, *Carl-von-Ossietzky University*, Replicating a Revolutionary's Experiments: Jean Paul Marat's Scientific Approach

Chair: David B. Wilson, Iowa State University

NINETEENTH-CENTURY BRITISH SCIENCE, CULTURE, AND PUBLIC

GRAND BALLROOM D

Martin Fichman, *York University*, Alfred Russel Wallace's North American Tour: Transatlantic Evolutionary Theism

David A. Riley, *University of Manchester*, 'Science Lectures for the People': Problems in the Public Understanding of Science in 19th-Century Britain

Linda C. McCabe, *Sonoma State University*, Origins of the Cultural Image of the Cave Man

Chair: Cornelia Lambert, University of Florida

SCIENCE IN EASTERN EUROPE AND THE EAST

GRAND BALLROOM E

Susantha Goonatilake, *New School for Social Research*, The Inflow of Major South Asian Textual Material into Contemporary Psychology

Gary J. Hausman, *University of Manchester*, Making Medicine Indigenous:

Program Schedule

Homoeopathy in Madras [India]

J. A. Krikstopaitis and **Romualdas Sviedrys**, *Polytechnic University*, History of Science behind the Iron Curtain in the Baltic Nations

Chair: Dong-Won Kim, KAIST

SATURDAY, 5 AUGUST

3:30-5:30 P.M.

**Denotes Session Organizer & Special Millennial Sessions*

SCIENTIFIC COMMUNITIES

GRAND BALLROOM A

John Suppe, *Princeton University*, The Tandem Bicycle Ride: Exponential Growth of Science and the Academy in the 19th and 20th Centuries

Dong-Won Kim, *KAIST*, Australians and Canadians at the Cavendish Laboratory in the Early Twentieth Century

Anna Binnie, *Macquarie University*, From Atomic Energy to Nuclear Science

James W. Endersby, *University of Missouri*, Collaboration, Authorship, and Scientific Research: Trends and Patterns Among Disciplines

Chair: Roderick W. Home, University of Melbourne

SCIENCE MUSEUMS AND THE DISPLAY OF KNOWLEDGE

GRAND BALLROOM B

Linda E. Endersby, *University of Missouri*, The “Stepchildren” of Science: Engineers and Technology in the Hallowed Halls of Science Museums

Tom Scheinfeldt, *University of Oxford*, Constructivist Historiography: Some Implications for Science Museums

Chair: Ellen Valle, University of Turku

CULTURAL AND SOCIAL STUDIES OF SCIENCE

GRAND BALLROOM C

Paromita Chakravarti, *Jadavpur University / St. Catherine's College, University of Oxford*, Juan Huarte's *Examination of Men's Wits*, 1594 and the Historiography of Mental Disability

Scott L. Montgomery, *Independent Scholar*, Translation and the History of Science: An Overdue Subject

Michael C. Soller, *University of California, Los Angeles*, History, Memory, Emotion: Episodes in American Historical Practice

Chair: Elihu Gerson, Tremont Research Institute

POPULAR SCIENCE?*

GRAND BALLROOM D

***Aileen Fyfe**, *University of Cambridge*, Industrialised Conversion: Publishing Popular Science and Religion in Victorian Britain

Suzanne Le-May Sheffield, *Dalhousie University*, ‘Beyond Popularization’:

Women Naturalists Exploring Science

Carsten Timmermann, *CHSTM, University of Manchester*, 'Folk Knowledge' and Professional Politics: Medical Historians and Popular Science in Inter-war Germany
Commentator and Chair: Jonathan R. Topham, Universities of Leeds and Sheffield

READING AND WRITING MEDICAL HISTORY RHETORICALLY*

GRAND BALLROOM E

Philip M. Teigen, *National Library of Medicine*, Language, Logic, and the Historiography of Medicine

Jill G. Morawski, *Wesleyan University*, Tales of Sperm: The Storied Historiography of Artificial Insemination

David N. Harley, *University of Notre Dame*, The Present in the Past: Charles Webster and the 17th-Century Prehistory of the NHS

Commentator: Theodore M. Brown, University of Rochester

Chair: Conevery Bolton Valencius, Washington University, St. Louis

RECEPTION

5:30-6:30 P.M.

FOYER A

PLENARY SESSION

6:30-8:00 P.M.

“WHAT IS TO BE DONE”

Lesley B. Cormack

Ludmilla Jordanova

Ronald L. Numbers

James A. Secord (moderator)

GRAND BALLROOM F

BANQUET

8:00 P.M.

REGENCY A/B

ABSTRACTS

Maher Aly *Alexandria University*

Medical School Traditions In Ancient Egypt

The main purpose of the recent research can be noticed within the whole context of the Ancient Egyptians knowledge of Science. The flourishing of Science in one aspect was accompanied with vital consequences in other Sciences. One can ask to how extent medical education assemblies present certain knowledge about practicing medicine? What are the methodological elements implied in that kind of teaching? However, while searching the nature of medical assemblies, one is inclined to deal with the continuity of these assemblies: Is there any relation to these assemblies with the Greek ones? And if there is any relation: what elements remained in the Greek medicine, and what was left? No doubt, the referred question is an epistemological one. If the answer proved the continuity of the ancient Egyptian medical educational assemblies, this will be of great help within the context of dealing with the tradition of the Alexandrine School. If we proved the continuity (or perhaps, the transition) of the Egyptian traditions within the Greek and the Alexandrine medical teaching, then we can claim the possibility of the existence of such elements in the Arab medical teaching. The turning point in the above cited idea is that the continuity of such idea represents a major shift in the epistemological of continuity through a very long period of time, and this in turn will reveal new problems.

Paul T. Arpaia *Baruch College*

Evolving into Italians: Evolutionism in Giosuè Carducci's Conception of Italian Cultural and Political Identity

In the debate over the origins and nature of Italian Fascism, recent studies have argued that Fascism—usually thought of as an heir to modernism and antipositivism—owes instead a greater debt to nineteenth-century positivism and scientific theories. These studies focus on pre-Fascist and Fascist “intellectuals,” social scientists who embraced Fascism, or prominent politicians such as Benito Mussolini. However, they fail to consider the Nationalist wing of the Fascist Party whose members came primarily from humanistic backgrounds and who were avowed opponents of “Darwinism,” positivism, and atheism. The Nationalists, who merged with the Fascists in 1923, were key players in the political and cultural life of Italy. They facilitated Mussolini's rise to power in 1922, salvaged his government during the Matteotti Crisis of 1925, held key cultural and academic positions in the 1930s, and helped orchestrate Mussolini's arrest when the tide of World War II turned against Italy in 1943. This paper will analyze the impact of scientific theories on Giosuè Carducci, a Nobel laureate in literature, professor of literature at the University of Bologna, and one of the primary intellectual influences on the Nationalist wing of the Fascist Party. His conception of culture and politics served as a central component of the Nationalists political program and was adopted by the Fascist Party upon the merger of the two parties. Recognized as the “poet of

the Third Italy” prior to Fascism, Carducci was elevated to the Fascist Pantheon of intellectual precursors by Mussolini. The paper will show that Carducci’s formulation of Italian culture and politics borrowed from neo-Lamarckism, while his conception of culture bore strikingly similarities to Ernst Haeckel’s Biogenetic Law. Despite his reliance on scientific theories, the paper will argue that Carducci’s conception of culture and politics was more the product of poorly-assimilated scientific theories than a logical consequence of them. The indirect influence of nineteenth-century scientific theories on Carducci and the Nationalist wing of the Fascist Party suggests the need to reconsider the role science and scientific theories played in nineteenth-century intellectual, cultural and political circles and, in particular the debt Italian Fascism owed to nineteenth-century science.

Renzo Baldasso *University of Oklahoma*
Galileo’s *Dialogo* and Scheiner’s *Rosa Ursina*

This paper explains why Galileo abandoned his theory that the sun moved the planets. The first part of the paper reviews the evidence for Galileo’s theory that the sun’s axial rotation was the cause of planetary motions. This claim appeared repeatedly in Galileo’s writings from the period 1611-1615 and was presented as the most important argument for the heliocentric cosmos. Perhaps because he later abandoned it, scholarly accounts have considered it to be mere rhetoric. However, both Bruno and Kepler believed that Copernican dynamics required a rotating sun. Galileo’s telescopic investigations of the sun “demonstrated,” through the discovery of the sunspots and the analysis of their movements, that the sun had an axial rotation with the period of a lunar month. This fact supported the conviction that the sun guided planetary movements. The second part of the paper considers the few statements contained in Galileo’s 1632 *Dialogue*, from which I conclude that the sun’s axial rotation no longer was the direct cause of the planets’ motions for Galileo. He had to abandon this important theory in light of the research on sunspots carried out by Jesuit astronomers. In fact, in 1630, after eighteen years of careful sunspots observations, Christopher Scheiner, the leading Jesuit authority in astronomy, had published his *Rosa Ursina*. Scheiner presented overwhelming evidence to exclude the possibility of a causal connection between the sun’s axial rotation and planetary motions. His arguments hinged upon both the period of the solar rotation and the inclination of the sun’s rotational axis.

Ruth Barton *University of Auckland*
”Men of Science”: Language, Identity and the Professionalization of British Science, 1850-1880

This paper approaches the issue of the professionalization of British science in the mid-Victorian period by examining the language which members and would-be members of the scientific community used both to describe themselves and to identify groups within the community. “Men of science” (the most common self-description) identified “students,” “workers,” “advanced students,” and “amateurs,” but very seldom referred to themselves as “professionals.” Specific expertise was usually referred to by the use of disciplinary labels, “chemist,” “palaeontologist,” etc. The

use of these and other terms will be examined with the purpose of understanding the boundaries which were maintained, and the principles of inclusion and exclusion which were expressed by different groups within the scientific community. The analysis will be based on diverse sources, including presidential addresses to the British Association, articles in the general periodical press, and personal letters.

Anna Binnie *Macquarie University*

From Atomic Energy to Nuclear Science

The Australian Atomic Energy Commission (AAEC) was established by an act of parliament in 1953 and ceased to exist, again by an act of parliament in 1987 when it was replaced by the Australian Nuclear Science and Technology Organisation (ANSTO). During its history the organisations' directions and research focus was very much dependent on what the government of the day saw as the role of atomic energy or nuclear science in Australian society. This paper will trace the story of the developments of the organisations which had their inception in the early years of the second world war, why the direction of the AAEC was changed into ANSTO and research foci of the organisations over the last 47 years of Australia's history. It will look at the role played by the organisations in uranium exploration and mining, atomic energy research and the developments of nuclear science and technology in Australia. Reference will be made to the impact of uranium mining on such issues as aboriginal land rights. It will also discuss some of the reasons why Australia which has the largest uranium deposits in the world does not have a single nuclear power reactor. The paper will conclude with a short synopsis of the research, developments and applications carried out by the organisations at its research site at Lucas Heights near Sydney.

Geoffrey N. Cantor *University of Leeds*

Rhetorics of Concord and Dissonance

The study of 'Science and Religion' has been dominated by propositional analysis. On the one hand many authors have sought to identify propositions that are to be found in both domains while, on the other, numerous other writers have emphasised the negation of religiously-based assertions by scientific facts. Such strategies seem unobjectionable if science is taken to consist of empirically-justified propositions. However, with the decline of positivism as a philosophy of science and the increasing appreciation of the role of rhetoric in science, new and potentially insightful approaches beckon. In this paper two forms of linguistic analysis will be explored, drawing principally on examples from nineteenth-century British authors. First, the vocabulary of science and religion will be analysed to show how words and meanings have been negotiated across these two (often overlapping) domains. Thus, for example, appeals to the 'laws of nature' were frequently given a theological gloss that aligned them with God's laws. Second, the language of design will be analysed to show that such arguments were not taken simply as inductive forms of reasoning that led from the claims about the natural world to the conclusion that God is its benevolent Creator. Instead the articulators of design arguments often deployed standard rhetorical strategies that carried emotional charge and would

thus carry conviction. These examples illustrate two ways in which historians can develop the study of Science and Religion in new and challenging directions.

Paromita Chakravarti *Jadavpur University /
St. Catherine's College, University of Oxford*

**Juan Huarte's *Examination of Men's Wits, 1594* and the Historiography of
Mental Disability**

My paper seeks to examine and evaluate the role of Juan Huarte's *Examination of Men's Wits*, [translated into English from the Italian version of the originally Spanish text (Baeza, 1575) by Richard Carew in 1594] in our understanding of the social history of mental disability in Renaissance England. The current academic interest in the evolution of notions of idiocy is focussed largely on the late seventeenth and eighteenth centuries. Although some work has been done on the legal (Richard Neugebauer) and institutional provisions (Peter Rushton, Jonathan Andrews) for idiots in the sixteenth century and on the literary representations of Renaissance folly (Enid Welsford, Sandra Billington), little or no account is taken of the medical discourse on mental deficiency prior to Thomas Willis' *De anima brutorum* (Oxford, 1672). My paper will investigate how, many of the revolutionary changes in Enlightenment ideas about idiocy, generally attributed to Willis, have antecedents in sixteenth century medical thought, particularly in Huarte's influential treatise which was translated into seven languages and reissued seventy times before 1700. The work is remarkable in its attempts at rationalising unusual mental functioning by explaining it as a somatic rather than a spiritual condition associated with either divine protection or demonic possession. Although he is writing within the basic parameters of humoral psychopathology, Huarte suggests that the brain and its temperature determines levels of intelligence and in so doing, anticipates Willis' claims about the central role of the brain and the nervous system in mental disturbance and disability. The aim of the paper is not merely to see Huarte as a progressive, even precocious precursor of Willis, but to locate important continuities between Humanist and Enlightenment thinking about idiocy. This would be done through a comparative analysis of the two English translations of Huarte, the 1594 version by Carew and the later 1698 translation by Edward Bellamy. The seventeenth-century translation marks a revived interest in an older text containing ideas similar to those being discussed in contemporary debates about the medical causes of idiocy, the problem of categorising the mentally disabled and about their social role. Huarte's work bridges two ages. It is hoped that a discussion of his book and its afterlife would provide a caveat against Foucaultian historiography which sees the seventeenth century as marking an absolute watershed in the history of mental deviance.

Tobias Cheung *University of Tokyo*

**Cuvier's Heritage: Living Architecture between Natural Burdens and
Regulative Devices**

Cuvier constructs organic bodies to reconstruct their living architecture. As a comparative anatomist, Cuvier designs innumerable models and defines their laws

of construction. In modeling the three dimensional inner space of animal caves perspectively, he works with bones, tendons and tubes to distribute the burdens prescribed by the nature of space itself: A heavy weight has to have stable legs as the columns of its bodily balance, supposed that its *manière de vivre* needs such a balance for its existence. Constructivist architecture is thus functional, and constructed for a certain end. But Cuvier's architecture of the living has also to consider the dynamic of repetitive processes within the animal "stove" which moves particles continuously from the inside to the outside, and back again into the cave. The "stove" requires a plan which includes a kind of organizational code, a program, for its regulative role. This deep aspect of the plan has itself no perspective deepness or physical weight, but exposes a topology of regulative devices which structure the movement of points within the time frame of the living processes. Between natural burdens and regulative devices, a set of conceptual tensions frames an ensemble which I will call Cuvier's heritage.

Paul C. Chrostowski *CPF Associates, Inc.*

Public Perception of the Evolution of the Dose-Response Relationship in Toxicology

In antiquity, substances taken into the human body were classified as either foods or poisons by both lay and professional communities. During the Renaissance and Age of Enlightenment, natural philosophers proposed the concept of the dose-response relationship as exemplified by Paracelsus' dictum, "the dose makes the poison." From this point to the present, there has been a division between professional and lay communities where the public conceives of "poison" as an absolute attribute of a substance and scientists conceive of "poison" as a matter of degree. Because toxicology is used as the basis of much current environmental and consumer product regulation, this difference in perception has contributed to loss of confidence in governmental regulatory agencies by the public. This paper explores the divergence of public and professional attitudes toward the dose-response relationship from antiquity to the present concluding with 20th Century concepts such as risk assessment and the precautionary principal which are basic tenets of regulatory policy. The concepts are illustrated with examples drawn from some common and some not-so-common poisons.

Benjamin R. Cohen *Virginia Tech*

On the Two Temperaments of Science and the Humanities: Those That Bridge the Divide and Those That Blur

This paper examines the relative position of C.P. Snow's two-cultures debate in terms of contemporary characterizations of science, culture, and the humanities. It views Snow's articulation as resting on a particular view of science that has been elaborated and superseded by science studies. Snow took the view that science, being forward thinking, could lead to a better world, whereas the humanities (specifically, the literary humanities) could not. The idea of those 'two cultures' in society has been present since well before Snow's isolation of the issue in the late 1950s. This specific invocation of the issue took place in Cold War Britain, when

science was still portrayed as superior, objective, and privileged. That is, the original lecture was historically situated before the post-Kuhn era of science studies had introduced new, sophisticated analyses of the practice and influence of science in and on society. Since then, science has been viewed in light of its relative claim to knowledge. The contributors to science studies - including constructivist histories, Kuhnian studies of non-cumulative progress, and elaborated sociological perspectives - took as their charge the need to understand how science is made and how it works in society. As such, in the intervening years, the divide of two-cultures has been either bridged or blurred by such fields as the history of science, sociology, anthropology, and literature and science. Furthermore, the interdisciplinary approach of science studies has reevaluated the entire premise of two sorts of intellectual inquiry, wherein the divide now lives within science studies, instead of science studies living across the divide.

I. Bernard Cohen *Harvard University*

Translating Newton's *Principia*

Newton's *Principia* presents a hurdle to readers in the new millennium because it is written in Latin and deals with a difficult subject. Our version had two seemingly contradictory goals—to make Newton's text available for readers of the new millennium while preserving its seventeenth-century character. We did not want Newton's text to have the form of a 21st century treatise. Another problem was the commentary. We followed the advice of colleagues, presenting Newton's text in Newton's words without extensive footnote annotations, incorporating explanatory comments into a preliminary "Guide to the *Principia*," organized so that reader can easily find a section or propositions under study. Thus the reader can study Newton's text with or without editorial aid. As translators-interpreters (every translator is an interpreter), we were awed by awareness that we would become responsible for discussions of Newton in the new millennium. We were encouraged, however, by the warm encouragement and enthusiasm of colleagues. These colleagues read either all or portions of the "Guide" and the translation and generously sent us detailed comments, criticisms, and suggestions for revision. The result was a text that is, in a very real sense, the work of many scholars. In my presentation I give examples of some pitfalls that beset a translator of Newton's *Principia*, demonstrating why a new translation was needed for the students in the 21st century. I shall conclude with some comments on future research needs and problems for the new millennium.

Peter Denton *University of Winnipeg*

Framing the Discourse: Science, Religion and the Hermeneutics of 'the Book'

Following Francis Bacon's declaration (*The Advancement of Learning*, 1605) that God revealed His divine will in both the Book of Nature and the Book of Scripture, the metaphor of the 'two books' has commonly been used to capture the encounter between Science and Religion. As scholarship on *l'histoire du livre* makes clear, the act of printing is a dynamic and culturally-constrained activity, such that the

product of that activity - the book - is a construction of much more than paper, ink and glue. This paper will explore the idea that, from its first articulation early in the history of print culture, the metaphor of the 'two books' has framed the discourse about science and religion in ways that result from the hermeneutic associated with viewing the book as an artefact. It will demonstrate how elements associated with the making and reading of books have shaped the relation between what has become known as Science and Religion, thereby framing discourse about knowledge, meaning and authority in terms which are contingent rather than necessary. Finally it will suggest alternative ways of framing this discourse outside the 'hermeneutics of the book.'

Lawrence S. Dritsas *Virginia Polytechnic Institute & State University*

The Nile Sources: Rereading the Journals of Discovery

This paper examines the events that led to the determination of the source of the Nile River in Central Africa. Captain John Hanning Speke is often credited with the discovery made while traveling with Captain Sir Richard F. Burton during 1857-1859. Using the explorers' own journals, it can be shown that the 'discovery' of Lake Victoria as the source of the Nile on 3 August, 1858 is based far more on conjecture than on physical evidence. Speke and Burton's personal opinions of Central African geography and their assessments of the truthfulness of local peoples' geographic knowledge contributed heavily to the observation reports they made at the Royal Geographical Society in London. The nature of discovery is questioned: can a claim be made for all the wrong reasons and still be correct? The subsequent debate between Speke and Burton demonstrates that discoveries are credited to individuals for many reasons beyond evidence alone.

Otniel E. Dror *Hebrew University*

Purity and Danger: Sympathy, Antipathies, and the Boundaries of Science

This paper studies the boundaries of science in early twentieth-century biomedicine. It draws on Mary Douglas' model of "Purity and Danger" to argue that emotion functioned as a conceptual pollutant that demarcated between the laboratory (pure) and the world (danger) the experimenter (pure) and his assistants (danger) and consensus (pure) and controversy (danger). Emotion defined these borders and implied a hierarchy. Each of these antithetical pairs is studied and it is argued that experimenters and clinicians differentiated between science and non-science by constructing emotional gradients on different levels of the laboratory and clinic. The paper then focuses in greater depth on the notion of "consensus" and examines how emotion was implicated in the breakdown of consensual knowledge among members of the scientific community. Emotions disrupted consensual knowledge, but they also resolved tensions by providing a rationale for controversy. Thus, emotion ultimately relieved the tensions that controversy entailed. The paper ends by demonstrating that experimenters and clinicians negotiated the tensions that emerged when emotions became a focus of laboratory discourse and praxis by constructing a complex relationship of sympathies and antipathies with emotions inside the spaces of knowledge production.

Sven Dupré *University of Gent*

Instruments and Embodiment in Art and Science

The recent stress on procedures, instruments, and embodiment in the history of science makes a reassessment of the interaction between the history of art and the history of science necessary. While for several decades, under the influence of Santillana, art and science focused on the intellectual content of art, with an almost exclusive attention to the mathematical codification of linear perspective, I will argue that art and science today has more to gain from a study of the painter's workshop practice. The attention to workshop practice, in art and science alike, reshapes the disciplinary boundary between the history of art and the history of science, even to the extent that this boundary tends to vanish, in agreement with the historical absence of a disciplinary boundary between art and science in the Renaissance and the early modern period. The gain should be that anachronistic questions, from the type "what's the influence of art on science?," are avoided to be raised in favor of more to the point questions about the shared embodiment and skill in the workshop of the "scientist" and the "artist." The possibilities opened up by the latter kind of research will be explained by taking examples of an analysis of Galileo's optics and optical instruments against the background of previous workshop practice.

Hamed A. Ead *Cairo University*

Earliest Chemical Manuscripts of the Chemical Arts in Old Egypt

Egypt is generally recognized as the mother of the chemical and alchemical arts, but unfortunately her monuments and literature have left little of the early records, which explain these arts. Some of these ideas have been transmitted to us through Greek and Roman sources but the character of these sources do not enable us to discriminate between the matter derived from Egypt and the confused interpretation or additions of the early Greek alchemists. Fortunately two important Egyptian works on chemical processes (Papyrus X of Leyden and Stockholm Papyrus) have been saved to our times. They are the earliest original sources on such subjects discovered at Thebes (South Egypt), and both formed part of a collection of Egyptian papyrus manuscripts written in Greek and collected in the early years of the nineteenth century by Johann d'Anastasy, vice consul of Sweden at Alexandria, Egypt.

James W. Endersby *University of Missouri*

Collaboration, Authorship, and Scientific Research: Trends and Patterns among Disciplines

The reward structure within the scientific community emphasizes publication credit, perhaps even over theoretical breakthroughs. This system of incentives produces many peculiarities inherent to the research process. Derek de Solla Price (1963, 1986) and Robert Merton (1968) made early contributions to the study of patterns of collaboration and coauthorship among scientists and within disciplines of science. Although there are a number of research efforts regarding authorship within individual disciplines, few investigators compare patterns of collaboration among several disciplines (Endersby 1996 is an exception but is limited to the social

sciences). Current research has said little about changes in the nature and the incidence of collaboration over time and in different disciplines. This paper examines coauthorship for published research among disciplines in the sciences “biology, chemistry, mathematics, physics, and others” focusing on differences with one another and across time. We classify credited authorship for every article in a dozen preeminent journals in the natural sciences over a 30-year period and identify trends in multiple authorship. The paper concludes with discussion of the growth of big science, and how credit-claiming is necessary and encouraged by changes of characteristics within a scientific community. We suggest how demand for authorship influences the nature of scientific research and how the history of scientific collaboration sheds light on the future of several disciplines.

Jim Endersby *University of Cambridge*

Putting Plants in their Place: Joseph Hooker and the Making of Amateurs

Although Joseph Dalton Hooker announced his commitment to natural selection in 1859, in the introduction to his *Flora Tasmaniae*, a close reading of his essay reveals an apparent ambivalence towards Darwin’s theory. However, I will argue that this is not a reluctance to embrace natural selection, but is a product of conscious equivocation over Darwinism’s implications. Hooker was concerned with “putting plants in their place” — taxonomically, geographically and professionally — all of which are inextricably inter-linked with mid-nineteenth century field collecting practices (especially their imperial/colonial context). Hooker relied on non-expert colonial collectors to provide specimens for his major floras, but this reliance conflicted with his desire to become a “philosophical botanist” (manifested particularly in his biogeographical and taxonomic theories). This tension was heightened by his anxiety over the status of botany as a discipline. Tracing the relationships between taxonomy, philosophical botany and disciplinary status provides a sense of what Hooker was attempting to do, and re-casts certain aspects of the “professionalisation” debate. I intend to argue that the newly-minted “professional” has to be defined in contrast to an equally novel role of “amateur” and that for Hooker, the latter were usually defined as colonials; their geographical isolation and lack of access to books and herbaria being just two of the factors that allowed him to set himself apart from them. Yet at the same time they were essential to his botanical enterprise. Putting plants in their place inevitably becomes a process of putting colonial collectors in their place as well.

Linda E. Endersby *University of Missouri*

The “Stepchildren” of Science: Engineers and Technology in the Hallowed Halls of Science Museums

The United States experienced rapid changes from the mid-nineteenth century, when the Smithsonian Institution was founded, to the late nineteenth century, when the Field Museum was founded. New groups, such as scientists and engineers, professionalized and the impact of the industrial revolution and technology in America became more pervasive. Technology attracted great popular attention. This paper argues that, while technology excited the popular imagination, it held

little sway in the institutions of science such as the museums of the Smithsonian. By the time of the founding of the Field Museum, technology found its way into the museum but was pushed out within the first decade. Technology's popular status may have even been an obstacle to its entrance into the museum world. Forces outside institutions, such as the Smithsonian, pushed technology inside in small bits. This paper describes the obstacles to those forces and argues that outside groups, such as engineers, turned some of those obstacles to advantage and managed to find a small, but permanent, place in the Smithsonian, although not a permanent place at the Field. The paper also examines why the outcomes at the two major science museums differed.

Martin Fichman *York University*

Alfred Russel Wallace's North American Tour: Transatlantic Evolutionary Theism

Alfred Russel Wallace's life and career provide an extremely cogent case study for the reassessment of traditional historiographic analyses of late Victorian science and culture. Although recent histories of late nineteenth-century evolutionary thought do not completely dismiss Wallace's interests in spiritualism, socialism, and theology as peripheral to his major contributions to evolutionary theory, they generally fail to regard those "other" interests as central to Wallace's mature evolutionary teleology. In this paper, I contend that Wallace's theological commitments came to not only permeate his evolutionary theory but functioned as constitutive principles for his emended vision of evolutionary science. In particular, his post-1870 publications, letters, and lectures provide indisputable evidence for the fundamental role theistic (as well as socio-political) beliefs served in his mature evolutionary synthesis. Wallace's year tour of North America (the United States and Canada) during 1886-1887 provides the focus of my paper. During that tour, Wallace was warmly received both as the leading statesman of "Darwinism" as well as a leading proponent of teleological evolutionary theism. His lectures in Boston, New York, Washington, Baltimore, San Francisco, Toronto, and Kingston (among other cities) attracted large and enthusiastic audiences. I will present an analysis of the reactions of his North American audiences, which included many prominent scientists and leading political and social figures, to demonstrate that Wallace's particular evolutionary synthesis exerted a powerful, and hitherto unstudied, impact on both professionals and laypersons who regarded his "other" interests as not merely compatible with evolutionary theory, but fundamental—and necessary—elements of a broader evolutionary worldview.

Aileen Fyfe *University of Cambridge*

Industrialised Conversion: Publishing Popular Science and Religion in Victorian Britain

The term "popular science," has come to be used by historians to cover any multitude of "non-expert," sciences, ranging from artisan botanists, to folk beliefs, to popularisations of science. However, the term came into use only in the early nineteenth century, to refer to efforts to explain the sciences to wider audiences,

usually through print. The numbers of such works grew rapidly in the 1840s, due to the industrialisation of book publishing. They were often anonymous, rarely by men of science, and controlled almost entirely by publishers and market forces, rather than by the scientific elites. These features made them a significant player in the debates over expertise and authority, which not only gave us our concept of scientific authority, but in so doing, denied all authority to “mere,” popular science. Given the importance of publishing in these debates, it is time for the increasing interest in book history to be applied to the 1840s. In this paper, I will show that publishers could have several reasons for producing popular science works, without necessarily having any desire to assist the public understanding of science. My main example will be the Religious Tract Society, who felt the need to oppose the pernicious effects of secular and atheistic works, by publishing with a Christian tone. This Society had an intense sense of evangelical mission, which made them determined to reach as wide an audience as possible, and the trouble they had in achieving this, illustrates the problems facing any publisher who hoped to popularise for the masses.

Elizabeth Garber *SUNY, Stony Brook*

Why Mathematics?

In the early nineteenth century the Europeans abandoned the rich metaphorical language of natural philosophy for theories expressed in the languages of mathematics. By 1870 mathematics was the language of a new subdiscipline, theoretical physics whose explanatory powers became ever more obvious. While historians have examined the varied ways in which this subdiscipline was established as the profession of physics consolidated in the nineteenth century, (Garber 1999, Jungnickel and McCormach, 1985) none have ventured an explanation for the turn to mathematics that began fifty years earlier. Here we examine the broad cultural, political, and economic forces, both long and short term, aiding and abetting these developments. While the specific characteristics of context and process were different across the western European states there were commonalities of interests and structures within France, the German States and Britain that “privileged” mathematics. The privileged status of mathematics discussed here developed from, (i) changes in the fiscal structure of the state (ii) the economics and politics of state and empire building (iii) changing commercial structures, as well as (iv) the place of mathematics in the cultural life of the elite. These factors will be highlighted while the dynamics internal to the growing international communities of natural philosophy and physics will not be neglected. Explicit examples will be taken from Britain, France and the German States.

Daniel Gasman *John Jay College, CUNY*

Ernst Haeckel in Italy: Monism and the Birth of Fascist Ideology

Somewhat surprisingly, the enormous impact of Haeckel and his Monist Philosophy on Italian science and culture has to date not received adequate notice. This paper, based on the research contained in my recent book, *Haeckel's Monism and the Birth of Fascist Ideology*, [1998] will attempt to demonstrate that Italian evolutionary

science was profoundly affected by Haeckel and that Haeckel's Monism played an important, indeed a critical role in the birth of Fascist ideology in that country. A substantial part of the presentation will be based on the importance of the letters found at the Haeckel Archives at the University of Jena — material that has only become available since the dismantling of the Berlin Wall. The material at Jena has tended to confirm the conclusions reached in an earlier work of mine, *The Scientific Origins of National Socialism* (1971), which analyzed the growth of Fascist ideology in Germany. It will be shown that important writers and thinkers who are ordinarily named as inspiring the birth of Fascist ideology were also at the same time committed disciples of Ernst Haeckel and his Monism. It will be argued, based on the new material, that Fascist ideology was born, not as some historians have argued, as the offspring of some particular social or economic system, nor as the result of an unfortunate historical defect or shortcoming in the evolutionary development of some national group or people, nor even as an ideological consequence of a host of general Social Darwinist, irrationalistic, vitalistic, and politically elitist ideas that rose to prominence in European culture in the decades around the turn of the twentieth century. Rather the development of Fascist ideology was a consequence of the direct and specific transformation of a widely held, popular scientific system of ideas into a political, philosophical, and religious ideology that acquired a revolutionary dimension. The ideology in question was the evolutionary Monist science and philosophy of the German zoologist, Ernst Haeckel, the author of a system of ideas that dominated significant aspects of European intellectual and cultural life during the final decades of the nineteenth and the early years of the twentieth century.

Peter Geimer *Universität Konstanz* (Unable to attend)

Noise and Nature: On Photographic Artifacts

Towards the end of the nineteenth century photography was treated as a medium able to see more than human eyes. The reduction of shutter speeds to times below 1/1000 sec. and the constant improvement of sensitive plates and objectives produced images beyond the human spectrum. More and more it became the function of photography to yield recordings of the invisible: rays, waves, fluids, ghosts and souls. In all these cases the photographic plate recorded what had no appearance beyond the plate itself. Photographic devices furnished images without perceptible models. In some cases these images were the only proof of existence of the recorded objects or phenomena. The information given by these recordings was hard to control, since no referents were available for comparative investigations. It often became doubtful what exactly had inscribed itself on the photographic plate: external referents or chemical and optical effects of the photographic process itself? Moreover, scientific representations of invisible phenomena could optically resemble those conspicuous blurs, spots, veils and dots that were normally treated as photographic waste, accident and failure. These demons of photography have been at work since the early days of the medium and every new photographic procedure has produced its own specific accidents. In this scenario, separating facts from artifacts became utterly problematic. My talk focuses on this specific

balancing between incident and accident. This point will be discussed on the basis of some case studies, including the scientific debate about so called fluid photographs (*‘photographies des effluves’*). Thus the talk deals with a sphere of knowledge in which the interpretation of visual recordings oscillated between technical noise and inscriptions of nature.

Jan Golinski *University of New Hampshire*

Tall Tales and Short Stories: Narrating the History of Science

To address the question, “What is to be done?” in history of science, I suggest we consider the narratives about science circulating in contemporary culture. As historians, we know a lot about how scientific discourse intersects with other cultural domains. I propose we make use of that knowledge to explore the available opportunities for creating richer and more varied narratives of science. The challenge is to engage the expectations of contemporary audiences while remaining faithful to the findings and perspectives of historical scholarship.

Gregory S. Goodale *George Mason University*

The Early Evolution of Evolution Theory

In the years following publication of *Origin of Species*, the scientists who accepted Charles Darwin’s theory of natural selection could not bring themselves to embrace the entire explanation. While Darwin demanded conformity to every aspect of his theory, his colleagues and allies, Thomas Huxley, Sir Charles Lyell, Alfred Russel Wallace and Asa Gray, sought a compromise regarding the theory’s application to the place of “Man” in the Darwinian scheme. Yet Darwin remained intransigent against what he termed “the arrogance of Man” during the years between the Darwin-Wallace presentation in 1858 and the publication of the *Descent of Man* in 1871, that period during a scientific revolution when a new theory struggles to overthrow the old. Though in retrospect victory was assured, it was by no means certain at the time that Darwin’s idea would prevail. Thus it is understandable that those scientists who favored natural selection might organize, plot and publicize in order to win the great debate. The most effective tool used in the effort to prevail, however, was compromise. As Darwin above all others placed a greater emphasis on winning the revolution, in 1871 he wrote a conciliatory disquisition in the *Descent of Man*. This, in the words of Charles Lyell, allowed individuals to draw their own inferences about the application of natural selection to Man. Darwin had compromised. The legacy of Darwin’s compromise is a debate among philosophers, scientists and naturalists over the distinctiveness of “Man.” The philosopher Peter Singer believes that the use of animals is unethical and founded upon an ideology without scientific foundation - an ideology that Darwin’s compromise suggests. The naturalist Jane Goodall has refuted distinctions between humans and animals (tool use, language, culture, pain) that scientists have believed for millennia - distinctions that Darwin’s compromise validates. An examination of the letters exchanged by Darwin and his colleagues and the books they wrote during this period explains why and how Darwin compromised to “the arrogance of Man,” thus fueling this great debate.

Graeme J.N. Gooday *University of Leeds*

Tempering and Amalgamating the Boundaries: Characters and Metals in the History of Science and Technology

This paper will argue that one of the many under-explored interfaces between the history of science and technology is the social history of materials. Although several historians of technology have written fascinating accounts of the 'social construction' of artificial materials, historians of science have had surprisingly little to say about the social factors in the history of so called 'natural' materials, specifically of metals. By looking at three case studies on the careers of Augustus Matthiessen, Werner Siemens and Marie Sklodowska Curie, I will consider how the career and credibility of individuals can be intimately bound up with the uses and 'trustworthiness' of the metals on which they worked early in their careers - albeit with not a little irony. The severely disabled Matthiessen established a career in the 1860s on the basis of his research expertise on copper - indeed one that posthumously outlasted his suicide in 1870 following accusations of sexual misconduct. His main aim had been to promote the reliability of silver/gold alloys as the basis for resistance standards - yet in this he was unsuccessful. His main antagonist in the 1860s was Werner Siemens, whom Matthiessen vigorously and very personally attacked for claiming far too much faith in the reliability and fidelity of mercury as the basis of resistance standards, despite the fact that much of the research published under Siemens' name was actually undertaken by his company assistants. Following the international controversies over the mercury in relation to standards for telegraphy, the main problem for those working in the later field of electric lighting was the problematic electromagnetic behaviour of iron. And it was the magnetic properties of steels that Marie Curie studied for her first ever research paper in the years 1894-6, gaining for herself a great reputation in engineering circles for her stamina and thoroughness in industrially-relevant research. Ironically, she herself later radically played down the importance of her early researches in this field, preferring to present herself as the unworldly (co)discoverer of radium. My conclusion will explore the complex inter-connections between the reputations of individuals and of the materials they researched, and draw out some historiographical suggestions for possible future studies in this area.

Matthew R. Goodrum *Indiana University*

Establishing a Place for the History of Prehistoric Anthropology and Archaeology within the History of Science

This paper argues that prehistoric anthropology and archaeology deserve greater attention from historians of science. First, because these sciences have generated significant ideas, discoveries, and theories and second, because many aspects of their history are intimately connected with developments in other sciences. Early interpretations of stone artifacts were connected with the problem of fossils, changing ideas about earth history had a profound effect on the study of human origins, and the rise of theories of biological evolution completely redefined the question of our species' history and relationship to the natural world. Since anthropology and archaeology developed in response to many of the same intellectual, social, and religious factors that helped shape other sciences, they

also offer valuable opportunities to investigate the relationship between science and religion or the ways that science reflected and affected widely held ideas about race, ethnicity, and political power. A vigorous inquiry into the history of these sciences will not only enhance our understanding of the history of the human sciences, but of the history of science in general. Moreover, integrating the history of prehistoric anthropology and archaeology into mainstream history of science research will have a profoundly beneficial effect on the way these disciplines are viewed and studied. This paper pursues its objectives by investigating some major historical themes in the scientific study of human prehistory and by briefly reviewing the current state of historical research into these sciences.

Susantha Goonatilake *New School for Social Research*

South Asian Philosophical Resonances and the New Physics: Influence or Resonance?

The new physics of relativity and quantum physics required a radical reorientation to the process of observation. In relativity all observational platforms were deemed to be equivalent and in quantum physics the act of observation itself changed the field of observation. The key figures in the two realms, Einstein and Shroedinger, had deep interests in aspects of philosophy, which resonated well with some South Asian philosophical positions. In the case of Einstein the two major philosophical influences on him, Hume and Mach, had views of the self as a transient observational platform, which was almost identical to the Buddhist position. Schroedinger owing debts to Mach declared in addition that he was a “Vedantist”, a category of Hindu philosopher. The strong parallelisms between Hume’s and Mach’s views of the self and Buddhist views of the self have been noted by several comparative philosophers and they have sought for evidence of Buddhist influences. Direct influences on both have drawn a blank, whereas strongly suggestive indirect influences abound. In the case of Hume of the influence of Chinese-Buddhist thought and in the case of Mach of his Buddhist inspired intellectual friends like Paul Carus. In the case of Schroedinger, recent research especially by Nair suggests that in fact there were direct transfers of philosophical orientations. It is suggested that especially where major breakthroughs require radical reorientations, mining philosophical bases of other civilizations could be a key strategy in the scientific enterprise.

Susantha Goonatilake *New School for Social Research*

The Inflow of Major South Asian Textual Material Into Contemporary Psychology

The last twenty years has seen a gradual inflow of particular exercises and therapies drawn from essentially South Asian techniques into the Western medical mainstream dealing with such conditions as panic attacks, anxiety and phobias as well as general behavior modification techniques. The paper documents this cultural drift by examining the medical, psychological and popular literature. Special attention is given to reports of careful laboratory experiments through imaging and other techniques that seem to verify observations in classical South Asian texts containing psychological material. A key example of the latter is the 5th-century Sri Lankan

text *Vissudhimagga*, a compendium on mental observation and psychological change whose descriptions of mental states have been correlated with particular psycho-physical states by Western laboratories. The gradual inflow of some of these South Asian techniques is examined through different stages: initial information about the techniques often mixed with disbelief on the part of the Western researcher, skeptical tests, then grudging acceptance followed by gradual inflow into the medical and main stream literature -in the process often forgetting the original Asian roots. It is suggested that a vast literature exists in South Asia on mental and psychological states to be used for modern medicine and psychology in much the manner that forest dwellers have vast knowledge of plants that could be fruitfully used by modern biotechnology. Estimates of the reservoir of this knowledge in the form of collections of relevant manuscripts are given.

Elizabeth Green Musselman *Southwestern University*

Forging Community through Bodily Sympathy in Industrial-era Natural Philosophy

Since at least the early modern period, sympathy has connoted both the physiological connections between bodily parts and a general sense of agreement or harmony (especially a community of feeling between persons). In this paper I will explore how these two definitions overlapped in natural philosophers' discussions of their own ailments. I will argue that natural philosophers built a sense of shared community based on their common interest in nervous physiology and philosophy, and their common experience of ill health or unusual experiences because of their own nervous conditions. In their correspondence, natural philosophers frequently shared advice on how to temper illness with good diet and exercise, how to mix pharmaceuticals, and so on. In public papers, they communicated their attempts to contain their bodily ailments with explanatory experiments and epistemology. While natural philosophers' interests were gradually fragmenting, a common interest in the effects of scientific work on the body — and the ability of natural philosophy to tame bodily variation — continued to attract general attention. In short, sympathy, in both its social and bodily sense, served as a bond tying together much of the natural philosophical community.

Elizabeth A. Hachten *University of Wisconsin-Whitewater*

Across the Revolutionary Divide: Epidemics, Science and the Russian State

Epidemic diseases still posed immense health challenges to the Russian state at the turn of the last century. Cholera, which had claimed at least two million lives in Russia during the 19th century, continued to appear regularly long after the disease had become only a memory in western Europe. Bubonic plague, another malady from the European past, staged a dramatic comeback in the southern and eastern borderlands of the empire after the mid-1890s. For Russians themselves, as well as their neighbors to the west, the prevalence of such epidemic diseases contributed to representations of Russia as backward and uncivilized, a “menace from the East.” And medical disasters only multiplied as the country entered a prolonged period of war, revolution, and social disorder in the first two decades of the 20th century. Epidemics of typhus, typhoid,

cholera, and a host of other infections threatened the armed forces and devastated civilian populations during World War One. The health crisis reached its apogee in the first years of Soviet rule as these diseases—their impact heightened by civil war and famine—posed a severe challenge to Bolsheviks' ability to govern. "Either socialism will defeat the louse or the louse will defeat socialism," warned V. I. Lenin in 1919. It was not until the mid-1920s that Soviet public health officials could confidently proclaim an end to this era of devastating epidemics. How did the Russian state, both Imperial and Soviet, respond to these challenges? More specifically, how were the findings of the new sciences of bacteriology and epidemiology deployed by the state's public health apparatus, and integrated into the existing armamentarium of public health measures? To what extent did state policies and practices change after the Bolshevik seizure of power? Was there a public health revolution comparable to the political changes of the period? This paper addresses these questions through an examination of the Russian state's patronage of the new science of bacteriology, tracing the emergence of a distinctive set of public health practices which combined deployment of bacteriological and immunological methods (diagnostic techniques, serum and vaccine development, identification of animal and insect vectors) with traditional medical police measures such as quarantines, sanitary cordons, and mandatory isolation of the sick. The state's approach to the threat of epidemics also entailed highly centralized control of resources and expertise. This set of practices developed in the context of the Russian government's plague control efforts from 1895-1914 which were carried out through a ministerial-level Anti-Plague Commission and the Imperial Institute of Experimental Medicine. These policies were resisted by many Russian medical scientists and physicians, who viewed the Tsarist regime's activities as arbitrary, oppressive, and reductionist. Ironically, however, the health crises created by Russia's involvement in World War I served to change the views of many of these critics. Physicians and bacteriologists who before the war had advocated public health programs based on sanitary and social reforms began to pursue narrower, centrally directed programs of disease control which relied on rapid identification of epidemic threats mandatory isolation and disinfection of the sick and the development, production, and administration of sera and preventive vaccines. In the context of total war, public health officials lacked the resources and personnel for broad-based efforts to ameliorate sanitary and social problems. A clear example of this shift towards reductionism and centralization in the Russian public health community as a whole can be found in the programs undertaken by the Union of Zemstvos and the Union of Towns in the period from 1915 to 1917. There is no doubt that the Soviet seizure of power brought great changes to many aspects of Russian medicine. But in the realm of epidemic disease control, continuity was the dominant trend, not revolutionary change. Not only were the infectious disease problems basically the same, but there was also striking continuity in personnel and institutional forms. The bacteriologists and epidemiologists who went to work for Narkomzdrav (the new ministry of health) had forged the earlier wartime epidemic policies some of them had also worked in the imperial government's anti-plague campaigns. The two agencies within Narkomzdrav that directed the fight against epidemics in the Civil War era—the Epidemic and Serum-Vaccine Commissions—had clear pre-revolutionary antecedents. And the policies pursued by these people and

institutions were strikingly similar to the pre-revolutionary models as well: a high degree of centralization focus on the control and eradication of germs, rather than alleviation of the social and environmental conditions that allowed epidemics to take hold and reliance on scientific “magic bullets” such as sera and vaccines. While there were multiple reasons for the decline of epidemics after 1922, the highly reductionist model of disease control inherited from the Tsarist era was certainly one factor in the Soviet success in this area of public health.

David N. Harley *University of Notre Dame*

The Present in the Past: Charles Webster and the Seventeenth-century Prehistory of the NHS

Charles Webster has been one of the dominant figures in the social history of medicine for at least a quarter of a century, since the publication in 1975 of his classic work, *The Great Instauration: Science, Medicine and Reform, 1626-1660*. He was one of the founding figures of the Society for the Social History of Medicine and he was the founding Director of the Wellcome Unit for the History of Medicine in Oxford, which was home at some time during his tenure to many of the most important practitioners of the social history of medicine, such as Roger Cooter, Anne Harrington, Ludmilla Jordanova, Irvine Loudon, Michael MacDonald, Hilary Marland, and Margaret Pelling, to name only a few. Since the completion of his work on seventeenth-century England, he has been the official historian of the National Health Service and has written extensively on modern topics as well as developing his expertise on the work and influence of Paracelsus. Many aspects of the early work of Charles Webster are worthy of note, such as his role in developing the Merton thesis on Protestantism and the rise of science, his pioneering exploration of the Hartlib Circle, his analysis of the millenarian aspect of the Baconian project, and his social study of such institutions as the College of Physicians and the early Royal Society. This paper will consider the extent to which his study of medicine, especially in Chapter 4 of *The Great Instauration*, was coloured by his own political context. As a refugee from Nazism who was brought up in Yorkshire during the foundation of the National Health Service, and having a strong interest in socialism and socialized medicine, Webster’s view of the medical reformers of the seventeenth century was inevitably coloured by his view of the present. In a sense, he saw them as the precursors of those who had so recently campaigned in favour of the NHS, an institution under threat at the time he was writing, just as others saw the Levellers and the Diggers as precursors of modern left-wing movements. This was a stimulating move within the history of medicine, focussing attention at a level far below the usual heroes of the disciplinary history of medicine, just as the later work of Christopher Hill drew attention to political actors far below the level of Archbishop Laud and Oliver Cromwell. For good or ill, this manoeuvre accelerated the separation between the history of science and the social history of medicine. However, the rhetorical presentation of the reformers within Webster’s account of English natural enquiry and medicine tended to marginalize other aspects of their thought and social circumstances, such as their precise religious and political positions.

William L. Harper *University of Western Ontario*

Newton's *Principia* as a Historical Introduction to Theory and Evidence

Studying the details of Newton's argument for Universal Gravitation can usefully inform understanding of evidential reasoning more generally in natural science. Topics from an interdisciplinary seminar involving faculty from physics and astronomy, mathematics, and applied mathematics, as well as faculty from the history and philosophy of science group at Western illustrate how informative studying Newton can be. Consider Newton's discovery of the dynamical significance of Kepler's harmonic law. To have the periods of the orbits of the planets be as the $3/2$ power of their distances measures the inverse-square power law for the centripetal forces maintaining those planets in their orbits. Agreeing measurements of this inverse square power law are provided by the absence of orbital precession for each orbit. Newton's inference from these measurements to an inverse-square centripetal acceleration field directed toward the sun is further backed up by having the harmonic law ratios for each of the planets count as agreeing measurements of the strength of this single acceleration field. The agreeing measurements of the inverse-square power law and of the strength of this field represent a kind of empirical success that goes beyond prediction. Newton's inferences appeal to theoretical background assumptions to infer theoretical parameter values from phenomena. They are backed up by systematic dependencies that make approximate phenomena carry information about approximate values of theoretical parameters. They are also robust with respect to approximations in the background assumptions.

Gary Hatfield *University of Pennsylvania*

History and Philosophy of Science: On Telling the Players

A question of some interest in philosophy of science is the construction of the identity of scientific disciplines and the implications such identities have for legitimating areas of study. A particularly salient philosophical question in the constitution of disciplinary identities concerns which sciences are counted as "natural science." Given the great popularity of naturalism in philosophy, how the line dividing the natural from the rest (nonnatural? supernatural?) carries great implication. I will argue that historians of science should also be interested in the philosophical aspects of this question, and that lack of attention to it has had curious effects in recent historical work on optics and psychology. Using examples of work on these disciplines in the 18th and 19th centuries, I will show how certain interesting historical questions, such as how optics changed from a theory of vision to a theory of light, or how psychology was transformed from an empirical discipline into an experimental discipline, have scarcely been asked due to a reading back of current disciplinary identities onto the past, or, in the case of psychology, due to the acceptance of a standard disciplinary history (framed with a specific naturalizing intent) which denied there was a discipline of psychology prior to the 19th century.

Gary J. Hausman *University of Manchester*

Making Medicine Indigenous: Homoeopathy in Madras [India]

Historical studies of Homoeopathy in Europe and the U.S. have focused on practitioners' attempts to emphasize 'modern' and 'scientific' approaches. Through a case study of

Homoeopathy in South India, this paper depicts an alternative scenario in which Homoeopathy remained unsupported officially owing to its exclusion from 'traditional' medical systems. In contrast with the three indigenous systems of Ayurveda, Siddha, and Unani, which received official support from the Madras Government from the time of the 1923 Usman Committee Report onwards, it was not until 1972 that Homoeopathy was supported officially in Madras State. From 1947 through 1950, Dr. T. Janakiram, an M.B., Ch.B. from Edinburgh University who had renounced 'modern' medicine to practice Homoeopathy, served the Madras Government as Honorary Director of Homoeopathy. He argued that Homoeopathy should be viewed as a section of Indian Medicine, and urged the Madras Government thoroughly to Indianise Homoeopathy and to link it with Ayurveda. His recommendations were rejected, on grounds that Homoeopathy was not an Indigenous system, but more closely allied to Modern Medicine. Yet, two decades later, when Homoeopathy finally was recognized by the Madras Government, it was allied with the 'indigenous' medical systems of India, by being brought under the rubric of the Director of Indian Medicine & Homoeopathy. Through historical contrast with the pluralistic medical situation in India, I suggest that the Euro-American trajectory of the triumph of 'scientific' medicine over Homoeopathy was not inevitable, and that in different historical circumstances Homoeopathy could better flourish through alliance with 'traditional' medical systems.

Peter Heering *Carl-von-Ossietzky University*

Replicating a Revolutionary's Experiments: Jean Paul Marat's Scientific Approach

The method of replicating historical experiments as an approach to learn more about historical experimental practice has been fruitfully applied on several case studies of successful experiments. What is to be done is to demonstrate that this approach can be useful in the case of the scientific 'losers': this can mean to deepen the understanding of their experimental researches as well as to gain new insights why they were refused by the scientific community. Therefore, in my paper I am going to discuss the work of one of the 'losers' that has been analysed with the replication method: In the 1780s, the physician and revolutionary-to-be Jean Paul Marat tried to establish himself as a natural philosopher. In doing so, he published several monographs on heat, electricity and optics in which he described series of experiments which were intended to establish his theories. From his writings, it is obvious that he wanted his readers to believe that his approach was purely inductive. Marat failed to gain the recognition of the Parisian Academy of Science and thus to attain the status of an acknowledged member of the scientific community his theories were rejected by most of his contemporary scientists, Marat can be looked upon as a 'loser' in the history of science, although not a typical one: after the French Revolution he was described in many accounts as a scientific charlatan. On closer examination, this seems to be astonishing as Marat's critics reacted mainly against his theories whilst some of them accepted his accounts of his experiments. In order to develop a better understanding of his experimental practice, some of the experiments Marat had published were replicated. In this paper, the experiences that resulted and the difficulties encountered will be described and conclusions on Marat's scientific practice and their meaning for his failure will be drawn.

Anke te Heesen *Max-Planck-Institut für Wissenschaftsgeschichte*

Closed and Transparent Orders: How the Furniture of Collections was Seen in the Enlightenment

The growing interest in natural history in the 18th Century can be demonstrated by the boom in ownership of natural history cabinets of that time. They were owned by physicians, natural historians, or amateurs. Within the cabinet, specimens were named and classified, ordered and stored. These activities demanded tools such as paper and ink, books and boxes. A special tool of this period, and very obviously fundamental to a cabinet, was the cupboard in which naturalia were kept. Through a study of depictions and descriptions of natural history cupboards, we might answer the question of how natural history was presented, and how the manners of presentation changed during the 18th century. By analysing the structure of the cupboard, I will argue for the emergence of a different mode of access to naturalia, in the transition from a largely haptical appreciation of the objects of nature to a largely visual one. On the one hand, such a study provides an example of how pictures can be used as a historical (re)source, while on the other hand we can see how they served to express a certain style of presentation. It is the aim of this paper to show how nature was visualized, and, in the same time, to offer a closer look at the practice of visualization itself.

Hester K. Higton *University of Exeter*

Does Using an Instrument Make you Mathematical? ‘Mathematical Practitioners’ of the 17th Century, and Their Instruments

The end of the sixteenth century in Britain saw a large growth in interest in mathematics, through increased publication of mathematical texts and production of mathematical instruments. By the beginning of the next century a community of people using the new mathematical skills had developed. However, those who were termed ‘mathematical practitioners’ - surveyors, navigators and the like - may not necessarily have merited the name. This paper will explore the ways in which the use of mathematical instruments both helped and hindered practitioners in developing an understanding of mathematics.

Don Howard *University of Notre Dame*

Kith or Kin? On the Relationship between History and Philosophy of Science

Does the term, “history and philosophy of science,” denote a unitary subject matter or just a non-null intersection of otherwise disparate interests and academic specialities? Though much debated, especially since the publication of Kuhn’s *The Structure of Scientific Revolutions* (1962), this question remains an open one. While many of us in both fields want to believe that the best philosophy of science is historically informed and that the best history of science is philosophically informed, there is no consensus regarding the manner of these informings. We seem to lack adequate conceptual tools for theorizing the relationship between the history and the philosophy of science. Symptomatic of this lack is the fact that, of late, anti-realism has had a widespread, if not always salubrious effect on the historian’s craft, though it is not obvious that the majority of philosophers of science would regard anti-

realism as a firmly established result of our investigations. On the other side, historical evidence, usually in the form of case studies, is regularly adduced to support philosophical claims about such things as the interpretation of scientific theories or the adjudication of intertheoretical disputes, but most historians of science cringe at the often naively uncontextualized way in which the case studies are presented. Approaching this problem from my perspective as a philosopher of science, I want to argue that the source of the difficulty is our having accepted a set of philosophical assumptions about science that make impossible any rich integration of historical and philosophical perspectives. Foremost among these assumptions are the related distinctions between the context of discovery and the context of justification and between epistemic and non-epistemic criteria of theory choice. We need to ask, first, from an historical point of view, how these distinctions came to be introduced at mid-century and how they came to play such a central role in late-twentieth-century philosophy of science. I will argue that, in addition to the more narrowly philosophical arguments advanced on their behalf, there were important, if now mostly forgotten political reasons for the valorizing of these distinctions. We need to ask, second, whether there are philosophically interesting alternatives. I will argue that there are alternative ways for the philosopher of science to theorize the relevance of context without, thereby, necessarily undermining the objectivity of science. Proceeding, again, historically, I will suggest what such alternatives might be by re-examining some neglected themes in late-nineteenth- and twentieth-century philosophy of science, chief among them being Ernst Mach's historical-critical method and Otto Neurath's distinctive variety of Duhemian underdeterminationism.

Frank A.J.L. James *Royal Institution*

Harriet Moore, Michael Faraday and her Watercolours of the Interior of the Royal Institution

The collections of the Royal Institution contain eight watercolours showing scenes of the interior of the Royal Institution, including its laboratories. They were painted by Harriet Jane Moore seemingly in the 1850s. Two of these paintings are constantly used in monographs and textbooks on nineteenth century science to illustrate what a laboratory looked like then. Yet, despite their familiarity, they have been little studied and their painter even less so. She is occasionally mentioned in directories of nineteenth century artists, but only in reference to these two paintings. What I want to do in this paper is to discuss the contexts in which these pictures were painted and what they represent. They show that she painted in the private spaces that Faraday and his family occupied (that is his laboratory where he worked and his flat where he lived). Furthermore she depicted aspects of some of the most up to date science that Faraday was undertaking at that time. This suggests that there was considerable interaction between the artist and the subject. How this interaction occurred in the context of the wealthy middle classes of mid-nineteenth century London is the subject for this paper.

Ludmilla Jordanova *University of East Anglia*

Visual Culture and Scientific Practice

It is striking that until roughly the middle of the nineteenth century, few attempts

were made to represent science as an activity. While it is difficult to provide a simple explanation for this situation, a number of questions immediately arise which are worth careful consideration. So the paper begins by considering the issue of how practice (a theme that is assuming increasing importance in the history of science) can be represented visually. All forms of practice pose a challenge in this respect, certainly before the advent of photography, but scientific ones seem to have been especially problematic. They are, in some rather precise ways I shall define, *private*; they involve activities that do not easily translate into visual form. Just as important are the artistic conventions that are available at any given moment. I shall discuss these and focus especially on the use of accoutrements in portraits to stand for scientific activities. How can objects evoke practices? A small number of case studies will be used, largely from the eighteenth and nineteenth centuries. I shall mainly be drawing on work done for *Defining Features: Medical and Scientific Portraits 1660-2000* (the book and the exhibition).

Dong-Won Kim *KAIST*

Australians and Canadians at the Cavendish Laboratory in the Early Twentieth Century

This presentation aims to analyze the activities of Australian and Canadian researchers at the Cavendish Laboratory in the early twentieth century. From its beginnings, the Cavendish provided the former British colonies of Australia and Canada with prominent teachers, notably R. Threlfall and W. H. Bragg (Australia) and E. Rutherford (Canada). Later, the Cavendish also offered these countries a fertile training ground for advanced physics students. The “Cavendish connection” clearly was crucial to the development of the Australian and Canadian physics communities. But, how did it start? Which Australians and Canadians traveled to the Cavendish and what were their purposes in doing so? What effects did the Cavendish have on their learning and future career patterns? Finally, what influences did the Cavendish Laboratory ultimately exert on these two former British colonies?

Ki-heung Kim *University of Edinburgh*

Controversy on the Nature of the Scrapie Agent in the 1960s

Although the so-called madcow disease is a very controversial disease in current Britain, its prototype known as scrapie and occurring in sheep has a long history in Britain and Europe. The first official records of scrapie in Britain date back to 1752. Until the 1960s, there had been no full-scale scientific research into this mysterious and fatal disease. During the 1940s and 1950s, biologists and veterinarians attempted to uncover the nature of this disease in terms of conventional biological and veterinarian methods, but the result was total failure. However, in the 1960s, some groups of scientists began to conduct scientific enquiries in Britain. There were two main centres of scrapie research, and they produced significant speculations as to the nature of this disease during the 1960s one was the Edinburgh-based research group, and the other was at Compton, England. Each scientific community produced opposite scientific speculations of the nature of the disease based upon their radiobiological experiment the latter group speculated that there

was no nucleic acid components in the agent of scrapie, to the contrary, the former group claimed that though the agent was too small to detect, the pathogenesis of the disease showed it to have a certain type of nucleic acid structure. This controversy provides a sort of prototype for current disputes on the nature of mad-cow disease. In this paper I will describe what the two groups achieved within this subject and why they produced such opposing theories. In this controversy, many peripheral, but critical factors, e.g., disciplinary background, institutional competitions, styles of doing science and so on, were involved and influenced to make consensus of this subject. I also examine these factors in my paper.

Charlotte Klonk *University of Warwick*

Artful Science: Natural History and its Images in Eighteenth-Century Europe

In the eighteenth century the boundaries between art and science were not yet clearly marked. The many sumptuous publication produced by geologists give an indication of the breadth of the educated public's interest in scientific research. These publications were illustrated with views which drew on contemporary artistic conventions for the depiction of nature. The implications of these conventions often stood in blatant contradiction with the theories they illustrated, as I shall show in the case of the first volumes of Buffon's *Histoire naturelle*. In the course of the eighteenth century, the theories of natural historians themselves increasingly came to influence landscape art, however. It is often forgotten that it was natural historians such as the Swiss Johann Jacob Scheuchzer, who first adapted the previously purely literary category of the sublime not only to convey the vast character of mountains with their dreadful precipices and irregular features, but also to give visual expression to their temporal dimension. The mountains were believed to be the residues of the first ages of history and the aesthetic of the sublime was used to convey the huge gulf in time that separates the contemporary observer from the formative events in the earth's history. What distinguishes eighteenth-century geological representations, including the diagrammatic depictions which came into use as the century developed, from their nineteenth-century successors is the way in which the former show successive stages in the history of the earth through the representation of immediately visible phenomena rather than by the conventional abstractions of later geological maps and stratigraphic depictions. What brought art and science together in the eighteenth century was their common quest for knowledge of nature *within* the realm of the senses. When this common ground disappeared there would never again be an aesthetic within which all three constituencies, the scientists, artists and the broader public, could represent and comprehend the earth's long history.

J. A. Krikstopaitis and Romualdas Sviedrys *Polytechnic University*
History of Science behind the Iron Curtain in the Baltic Nations

The three Baltic states have been active in the field of history of science for the past fifty years. A major turning point was the inauguration in 1958 of bi-annual history of science conferences rotating among the three countries. Since 1990 it has attracted

scholars from western Europe and with it, a more frequent use of English or German languages at our meetings. The *Acta historiae scientiarum baltica* is published in Riga and has been the main vehicle for publishing, in addition to a series of national publications in the national languages. In 1993, the Baltic Association of the History and Philosophy of Science became a member of the International Union of the History and Philosophy of Science. And starting with fall semester of 1999, Lithuania was the first Baltic state to introduce a Master's degree program in the History and Philosophy of Science. The program took some ideas from the United States and eventually, given time and resources, may develop into a full Ph. D. program. It is located at the Kaunas Technological University and its first graduating class will have about a dozen students. In Lithuania, during the Soviet occupation, history of science was a vehicle for resisting soviet ideology and russification of society. That function is no longer a prime interest of the rising generation of historians of science since Lithuania's independence achieved in 1991.

Russell M. Lawson *Oklahoma School of Science and Mathematics*

The Pious Scientist: Jeremy Belknap, the New Science, and Christianity

Eighteenth-century New England was a center of controversy respecting the challenge of the New Science to traditional Christian assumptions of God's active will and man's uncertain fate. Jeremy Belknap (1744-1798) was an Enlightenment thinker who tried to maintain Christian legitimacy notwithstanding the attacks of Deists and other skeptics. Belknap was a geographer, historian, biographer, and northern New England's most accomplished naturalist. Scientific study forced Belknap, a Congregational clergyman, to reconsider the Calvinist dogma upon which he was raised. Navigating his way between the Scylla of Old Light doubt and the Charybdis of New Light enthusiasm, Belknap tried to bring empirical methods to bear on the Gospels. He sought to reinterpret human nature according to his assumption of divine goodness. In his *Natural History of New Hampshire* Belknap forced the hand of natural theologians to reveal just how Nature, the Creation, is a mirror of God the Creator. However much inquirers then and now scoff at Belknap's integration of faith and reason, he was satisfied that the *sine qua non* of the scientific enterprise, and the most important characteristic of the scientist, was piety.

André R. LeBlanc *Université du Québec à Montréal*

The Problem of Post-hypnotic Suggestion in France, 1884-1896

The first half of this paper narrates how the concept of dissociation originated as a solution to the problem of post-hypnotic suggestion. The second half examines the logic of this solution and proposes that it may be radically false. In 1884, the philosopher Paul Janet (1823-1899) introduced the problem of post-hypnotic suggestion. Give a hypnotic subject the post-hypnotic command to return in 13 days. Awake, the subject remembers nothing yet he nonetheless fulfills the command to return. The problem then is this: how does the subject count 13 days without knowing it? The philosopher and psychologist, Pierre Janet (Paul's nephew) (1859-1947) proposed the concept of dissociation as a solution in 1886. He argued that a second consciousness kept track of time outside the awareness of the subject's

main consciousness. This was the origin of the concept of dissociation, which has become so prominent in recent years with the epidemic of multiple personality disorder, renamed dissociative identity disorder in 1994. In analyzing the concept of dissociation, I take up a debate between the Belgian philosopher Joseph Delboeuf (1831-1896) and the French physiologist H. Beaunis (1830-1921) over the implications of certain post-hypnotic suggestions for our belief in the possibility of free will. I attempt to show that one of the consequences of Delboeuf's argumentation is to demonstrate a logical flow both in the concept of dissociation and also in the associated theory, propounded by Janet and others, that memories of trauma can be forgotten yet affect our actions and thoughts.

Daryn R. Lehoux *University of Toronto* (Unable to attend)

Astronomy and Weather Prediction in Ancient Egypt

This paper deals with the *Saft el-Henna Naos* published by Christian Leitz (in his 'Tagewahlerei'). I show that the *Naos* preserves for us an otherwise almost unattested Egyptian interest in astronomical weather prediction. It uses observation of the fixed stars to forecast rain, heat, the Nile flood, etc. It also contains predictions of the prevalence of certain diseases at particular times of year. A close analysis of these passages reveals that the author(s) of the *Naos* text believed that the fixed stars, rather than simply indicating the possibility of these atmospheric and disease phenomena, actually caused these events on earth. This causal relationship will be fleshed out as much as possible, and the *Naos* text will be compared and contrasted to other Egyptian texts, in particular the *Calendar of Lucky and Unlucky days*, and the *Autobiography of Harkhebi*.

Rhona G. Leibel *Metropolitan State University*

Epistemic Disunity in the Study of International Relations: Assessing Interwar Idealism

The discipline I investigate is political science, and more specifically, the sub-field of international relations. As a community of scholars who purport to produce politically neutral models of the complexly patterned global system, but whose work is often used as the basis for justification of state action, this is an intriguing science to track historically. What has counted as legitimate knowledge when why? One theme that has both defined the discipline and kept sub-groups at odds with each other has been the centrality of the political realist research program. The larger project I am involved in is to see in which ways it makes sense to speak of a unified vs a disunified conception of knowledge in this discipline. I do this by mapping out the vagaries of acceptance and rejection of the realist program, both across sub-groups and over time. What I do in this paper is lay out the academic writings of the scholar/policy-maker most identified with the group long dismissed by much of the discipline as the antithesis of an acceptable realist research program. This group of actually very disparate scholars, 'idealists,' are often represented by the work of Woodrow Wilson. I argue that in Wilson's academic work, he can best be understood not as having failed to be 'scientific,' as realists charge, but as having a conception of explanation and justification different from those that underlie the

realist research programs. I end the paper by raising the question of whether assuming the possibility of disparate notions of explanation in science in general, and in their own discipline in particular, would have been useful to the discipline as it attempted, but failed, to explain the radical global changes of the 1980s.

Martin Lengwiler *University of Zurich*

Welfare State and Risk Society: The Historical Dimension of Current Risk Debates

Focusing on the discussions in Germany and Switzerland, the paper argues that the parameters of contemporary debates over the notion of health risks have been determined by the perception of risk developed by the Welfare institutions of a number of European states after the turn of the century. The history of the scientific conception of health risks is marked by three different stages, all linked to Welfare institutions. Before WWI, risk was predominantly a technical and mechanical term, closely related to the prevention of industrial accidents, and defined by engineers. Thus, this conception of risk was more practical than scientific. The second period, after WWI, led to the first scientific conceptions of risk within occupational hygiene and industrial medicine. As the case of silicosis shows, this scientific conception of risk was in fact part of a new conception of illness, based on statistical evidence and probabilistic calculations. The third period, after WWII, was marked by the rise of social medicine and its more generalized conception of health risks. Together with the development of public health institutions, knowledge about risk and risk prevention was popularized by a series of health campaigns which eventually led to the current public concerns about health risks. The paper argues that there would be no Risk society without the history of the Welfare state. Welfare institutions were among the first to grasp scientifically the future of individuals as well as of societies. Thus, this paper is a first step, too, towards a history of the future, seen as a set of conceptions and ideas on future events.

Ben Marsden *University of Aberdeen*

The Professional and Professorial: Engineering under Cover in the Early Victorian Universities

Studies of academic training for engineers in nineteenth century Britain have concentrated fruitfully upon the periods following either the Great Exhibition (1851) or the Paris Exhibition (1867). Debates have consequently tended to focus upon a late nineteenth century ‘age of inquiries’ into the nature of technical and scientific education, construed as remedial action for long-term comparative economic decline. In this paper I consider the rapid formation of classes, departments and professorial chairs of engineering in most British universities at an earlier time. The late 1830s and early 1840s constituted a time of dire economic malaise, extreme social unrest - and significant change in the university provision of technical education. Specifically, between 1837 and 1842 there was a cascade of new classes for engineers in Durham, Cambridge, University College London, King’s College London, Edinburgh, Glasgow, Trinity College Dublin and an independent “College for Civil Engineers” in London’s Kentish Town. Academic change was motivated both by the promise

and the threat of political, administrative and social reform. Engineering academics shaped their professorial practice to meet local circumstances, structures and markets, even as they sought to manufacture secular utilitarian “scientific professionals” or to socialize high ranking Christian gentlemanly professionals. There was competition between institutions and amongst professors as the occupants of science chairs sought alternately to block and to promote the academic training of engineering youth. In order to show the nature of the teaching of engineering at this time of innovation I outline the prosopography and practice of the professorial engineers. I further examine the relationship between the professorial engineer, the student or aspirant engineers, and the profession of engineering. I suggest that the heterogeneity of the engineering profession was matched by the multiple manners of getting to be a professional engineer. In a time of flux for the young Institution of Civil Engineers (founded in 1818 and chartered a decade later), there was ample scope for re-routing the paths to professionalism - or for making substantially new paths. Those promoting bookish, theoretical and gentlemanly civil engineering ‘under cover’ exploited parallels between the young hitherto apparently unlearned profession of engineering and the ancient learned professions, particularly the legal, medical and clerical professions. For these advocates the university class-room was, henceforth, to be an essential passage point on the educational itinerary of the professional engineer. In making such claims, the professorial engineers and their allies implied a re-evaluation of the authority vested in the ICE, a body which purported, alone, to define and represent the profession. Finally, I offer some suggestions on how examining the professional and the professorial engineering of the late 1830s and early 1840s might revise an older school of histories of academic engineering and technical education. First, accounts couched in terms of the implementation (or non-implementation) of state-intervention have to some extent obscured the importance of the micro-political agency of the largely self-governed and self-financed early Victorian University. Second, as this and many other studies show, the term “profession” is clearly useful as a way of structuring narratives of academic engineering: but by stressing its employment as an actor’s category, rather than seeking to impose general definitions, analysts can witness the diversity and the richness of the early nineteenth century engineering “profession” as a practice which might variously be “scientific,” “gentlemanly,” “Christian,” on a par with the learned professions, or indeed any combination of these. Recognising heterogeneity in engineering profession and tuition allows us further to undermine the myths that universities were univocally opposed to engineering education, that “science,” or even science professors, uniformly favoured it, or that training for British engineers in the nineteenth century was “better” in so far as it was “more scientific” (perhaps following German or French models). Science, of course, has its own history, and the history of academic engineering education can best be understood by taking this fully into account.

Linda C. McCabe *Sonoma State University*

Origins of the Cultural Image of the Cave Man

Neandertals have been subjected to insults since their introduction to the scientific world in 1857. The popular representation of the Cave Man contradicts current

scientific thought regarding Neandertals and interferes with the public's understanding of human evolution. Some scientists attempting to identify the source of this negative imagery have blamed Marcellin Boule. This study puts the origins of the Cave Man icon into an historical context and shows that it is far more complex than the work of one man. Procedure: Four periodicals (*Harper's New Monthly Magazine*, *Harper's Weekly*, *Illustrated London News*, and *Punch*) were surveyed from August 1856 until December 1923 for relevant images. These images were classified into categories such as: Wild Men, Hercules, Africans, Australians, caricatures of Charles Darwin with monkeys and Cave Man images. Findings: The first identified Cave Man caricature was in 1881, but it was not until 1893 that a stylistic convention surrounding the Cave Man started in earnest. The addition of a woman being dragged by the hair was not identified until Buster Keaton's movie "The Three Ages of Man" in 1923. Conclusions: The Cave Man Icon had many influences which includes: a long artistic tradition of depicting primitiveness by hairiness, wearing animal skins, carrying clubs as weapons and living in caves; a conscious rejection of Darwin's theories of evolution; the influence of physiognomy and phrenology; and prevailing racist attitudes of the day, including stories of violent bride capture by Australian Aborigines.

Susan McMahan *University of Alberta*

Inventing Botany at the Royal Society

By the late seventeenth century, a community of natural historians consistently began to identify themselves as botanists and their enterprise as botany. By 1690, there were more individuals actively engaged in this endeavour in England than elsewhere in Europe indeed the Royal Society had entered what one recent historian of the Society refers to as a period of Kuhnian 'normal science'. This represents the period during which the natural history project of John Ray F.R.S. (1627-1705) became fully established. My paper will consider the disciplinary transformation of natural history into the single agreed upon activity of Raian botany, which especially included the proper conduct of botanists, methodology and textual presentation, development of a working technical vocabulary, preoccupation with taxonomy, and an appropriate reward system. In addition, dedicated research and teaching facilities were established for training and educating botanists in the correct tradition. Raian natural history also became established as a powerful model for respectable Anglican activity and a legitimate expression of religious piety, which further reinforced the practice of botany in eighteenth-century English society.

Scott L. Montgomery *Independent Scholar*

Needed Revision in the History of Science and Art: The Case of Jan Van Eyck

Evaluations of the relationship between the history of science and the history of art have expanded significantly in recent years. The role of pictorial representation has been increasingly studied with respect to styles of observation that proved important to scientific uses. One area perhaps too little pursued to date involves pre-Renaissance trends in the naturalistic portrayal, particularly of non-organic

phenomena. It is now clear, for example, that one must push back the beginnings of a truly documentary perception of the natural world. The early Netherlandish painter Jan Van Eyck, known for a relatively small number of works performed between 1410 and 1445, makes this certain. Van Eyck provides a remarkable and wholly unparalleled example of naturalistic observation on the twilight of medieval pictorialism. Van Eyck is the first artist in the western world, possibly in the whole of world art, to paint aspects of the inorganic physical universe—astronomical, meteorological, and geological—in wholly realistic fashion. Indeed, the degree of realism in his Moon, clouds, and rocks is sufficient to permit a detailed contemporary scientific analysis. A century before Leonardo da Vinci and 200 years before Galileo and *Sidereus nuncius*, Van Eyck produced works that reveal an impulse to precisely record from nature directly. This raises inevitable questions about the origin of such an impulse at this early date. As a court painter in the employ of Philip the Bold of Burgundy, a somewhat flamboyant patron of intellectual activity, it is possible that Van Eyck was influenced by the Greco-Islamic tradition of natural philosophy and used this to inform the object materialism in which he lived and worked. His significance reveals that revisions are needed in existing histories of science and art.

Scott L. Montgomery *Independent Scholar*

Translation and the History of Science: An Overdue Subject

Knowledge, whatever its contents, is a mobile form of culture. Beyond any doubt, the transfer of learning has been critical to the building of societies, those we call “modern” most of all. Time and again, the introduction of new concepts and methods—Roman law, the system of Arabic numerals, the sonnet, Newtonian physics, natural selection—has proved the source of new capacities for ordering, directing, and expanding human existence. Placing the knowledge of one people into the hands of another involves the transfer of certain powers: powers of expression in the case of literary or artistic knowledge powers over the patterns and organization of life, in the case of political ideas and, in the case of science, powers of imagination and practice with regard to the material world and uses of it. Such transfer therefore defines a critical historical process: it is what scholars really mean when they speak (and they do so often) of “influence” between different periods or societies. Knowledge is rendered mobile by translation. This is what has made scientific understanding able to cross boundaries of time, place, and culture. Yet, despite its obvious importance, translation has rarely been a sustained topic of investigation among historians of science. Reasons for this may be related to unspoken assumptions about the nature of scientific language, its presumed universality. This belief deserves re-evaluation. It is clear, for example, that successive cultures—Rome, Islam, Persia, India, and Europe—nativized, and therefore left their individual imprint on, Greek astronomy. This suggests that western science is a complex amalgam and may not be identical today in different cultural settings. Such realities make it clear that study of translation as an evolutionary force in the history of science is overdue.

Jill G. Morawski *Wesleyan University*

Tales of Sperm: The Storied Historiography of Artificial Insemination

The history of the reproductive sciences and medicine has largely been a history of knowledge about female physiology and function. The minimal attention to male reproductive processes, including a virtual absence of monographic studies on the subject, indicates a partial historiography that re-inscribes the cultural associations linking women to reproduction and the body. However marginal men's reproduction is in these histories, it has been the object of substantial scientific scrutiny and medical intervention. One significant development has been artificial insemination (A.I.), a procedure that at once dispensed with the need for intercourse and altered what Mary O'Brien described as the "social fact of paternity." As part of a project chronicling male reproductive science, I located a number of histories of artificial insemination. Often imbedded in medical journal articles, attached to autobiographies, or appended to medical texts, these historical accounts tell of the procedure's scientific background, notable experiments, and early successes. Although varied in form and published over the period of a century, the accounts employ a historiography that is remarkably consistent in both narrative and rhetorical style. The histories are structured mainly through stories of adventure and alluring mystery: legends of surreptitious uses of semen, deceptions, and long kept medical secrets. In tone and detail, these narratives resemble the lore shared at family reunions - tales of ancestors' daring and clandestine pasts. Especially in the accounts of early practices, the male subjects are practically invisible, represented only by seminal fluids. Thus, the historiography is one of silence as well as secrets, thereby avoiding direct consideration of matters of paternity. Missing too from such adventure narratives are donors, ethics concerns, legal implications, and connections to veterinary science and eugenics ideas.

Falk Mueller *Carl-von-Ossietsky- University*

Experimental Spaces and Conceptual Development in 19th Century Gas Discharge Physics

In my work I try to trace some developments in gas discharge research in the second half of the 19th century. What I have been concentrating on has mainly been the historical creation of material (experimental, instrumental) environments in which gas discharge phenomena were produced, investigated and constituted as a physical phenomenon by researchers like Johann Wilhelm Hittorf or William Crookes. In the beginning of their researches, the production of gas discharge phenomena followed some principles of creation, which were easy to realize, and which led to a stunning variety of effects. The connection between these effects was maintained by their practices of creation, and by the space opened up by the vacuum contained in glass tubes. However, this was not enough to provide experimental or conceptual coherence. I am interested in the way different kinds of coherences and understandings were produced by means of instrumental and experimental design as an aim and as a product of the research process. Wilhelm Hittorf (1824-1914) and William Crookes (1832-1919) had a similar education and, although extremely different in their characters, had comparable research

interests. Their theoretical ideas led, however, to opposing explanations of the phenomena. Can we follow their conceptual development by tracing the material formation of their experimental world, of the experimental spaces they were using and transforming? What part may the replication of some of these experiments play in such a research project?

David P.D. Munns, *Johns Hopkins University*

Phytotrons: Where the Greenhouse met the Cyclotron

On one level this paper is about the creation of the next generation of greenhouses, phytotrons, which were climatically controlled, biologically isolated, and involved large scale computing technology. Starting at Caltech, the paper mainly looks at the transfer of this biological big science to Australia, the impact of the Green Revolution on the style of research done in plant biology, and the desire for increasing exactness, as exemplified by physics. But on another important level, the paper examines the 'semantic work' done by the term 'phytotron' itself. What did it mean for an instrument of science, particularly biological science, to be labeled a 'tron'? How did the semantics of instrument nomenclature affect funding strategies? And how did those semantics reflect or govern how plant biologists saw the place of their discipline in the postwar world? The example of the phytotron displays some of the movements within postwar science. We know that physics became largely 'paradigmatic,' but the mechanisms remain unclear and the transfer points unusual.

Michael Nauenberg *University of California, Santa Cruz*

The Role of Curvature in Newton's Dynamics

One of the most important tasks in the history of science is to elucidate the origin and development of scientific concepts. In this talk I will discuss the development of some of Newton's ideas which culminated in his great masterpiece, the *Principia*. The publication during the past decades of Newton's mathematical papers and correspondence has led to a reassessment of earlier narratives of this development, but some crucial aspects have remained controversial. In particular, the seminal role of Hooke's contribution in his 1679 correspondence with Newton has been obscured by a lack of understanding of Newton's approximate method to calculate orbital motion prior to this time. I will show that a letter of Newton to Hooke written on Dec. 13, 1679 demonstrates that Newton had a much deeper understanding of orbital dynamics than had been thought previously. I will argue that Newton's early computational method was based on his application of the concept of curvature which he had developed in the late 1660's. Hooke's suggestions led Newton to consider a complementary approach to orbital motion which led to his crucial discovery of the physical origin of Kepler's area law, which was hidden in his earlier curvature method. I will give evidence for the effect of Hooke's intervention on Newton's new approach to dynamics in 1680/1. In the first edition of the *Principia* (1687), Newton presented only his newer approach without discussing this curvature method, but later he presented it as an alternative approach in the second and third edition (Book 1, Prop. 6). This led to the general belief that

Newton had developed his curvature approach in the 1690's. I will illustrate, however, how already in the first edition of the *Principia* he applied the curvature method to the solution of difficult problems in resistive motion (Book 2, Prop. 15) and in lunar theory (Book 3, Prop. 28). I shall conclude with some further evidence that the curvature method was Newton's first approach to orbital dynamics although in the *Principia* he presented it as derived from other fundamental propositions.

Katherine L. Neal *University of Sydney* and John A. Schuster *University of New South Wales*

Practical Mathematics and Narratives of the Scientific Revolution

Over fifty years ago the classical externalist narratives of Hessen, Strong and Zilsel claimed that practical mathematics and practical mathematicians played a seminal role in the process of establishment of modern science. However, no consensus was reached on the issue, within or without externalist accounts, which in any case were then occluded in the Cold-War ambiance of internalist-biased eclecticism. Modern contextualism and social history of science has put practical mathematics back onto the historiographical agenda, with recent work by Bennet, Johnson, Cormac, Dear and others shedding new light on the field and its leading players. Less energy, however, has as yet been expended in revisiting the externalists, key question of the role of practical mathematics in the process of the the so-called Scientific Revolution, although hints and clues do appear in the newer literature. We propose one way forward for investigating the issue: We suggest that practical mathematics be treated as a tradition or sub-culture in dynamic process, and that the field of natural philosophising be treated similarly. This directs attention to the varied and nuanced relations and articulations that occurred between these fields over time. After briefly discussing the historiographical background to this problem we apply our model to three case studies: Gilbert and Wright—scholar and craftsman, or, natural philosophising and practical mathematicising, Tycho—between practical mathematics and the cosmological agon and the young Beekman and Descartes: subsuming Stevin's practical mathematics in the interest of natural philosophical revolution.

Elizabeth R. Neswald *Humboldt Universitaet zu Berlin*

Cyclical Cosmologies in Late 19th-Century Germany

Much has been written about the contribution of the natural sciences and especially the hypothesis of the heat-death of the universe to the pessimism of the late 19th century. A closer look at popular scientific works and philosophies in late 19th century Germany reveals a different picture. Far more prevalent than assumptions of a final heat death were theories which postulated an eternal cyclical universe. Since neither hypothesis could be scientifically verified, which hypothesis an author supported depended on his fundamental assumptions about the nature of the universe and was, in many cases, closely connected to a more general world view concerned not only with the development and fate of the physical world, but with the human world and the direction of society as well. In my paper I propose to examine the cosmological hypotheses of four German proponents of the cyclical universe

hypothesis - the philosophers Moses Hess and Friederich Engels, the physiologist and popular science writer Ludwig Buecher, and the astronomer Oswald Koehler - and to analyse the relationship of these hypothesis to their social and political views. Although these four scholars are only a few of those who supported cyclical theories of the universe, they have been chosen because they wrote not only on astronomical and cosmological theory but on political and social topics as well. Thus the connections between their cosmological and philosophical premises and their social and political views can be investigated and can perhaps shed some light on the premises behind other cyclical theories of the universe.

Igor Yu. Popov *St.-Petersburg Branch of the Institute for the History of Natural Sciences*

Analysis of a Prototype of “Case Study”

In numerous modern “case studies” very different aspects of the history of science are considered - biographies, scientific papers, social conditions, philosophy, etc. Is it necessary to analyse in every research “interconnected” histories in the unity and interaction or it would be better to separate them? This problem was stated at least 1500 years ago. Socrates, a historian of Vizantium, apologised to the readers for writing not only the history of church, but military one too. In a treatise he described the history of religious thought, the conflicts of bishops, political and military events. This historian explained the reasons of this fact: first, he tried to establish facts, and secondly, he did not like to bore a reader. Thus, he indicated the main sources of modern methodology: passion to collecting facts and not to the analysis with definite aim, and a desire to make a treatise more available and interesting for the readers, that is to sell it more expensively. Does this note anticipate modern methodology or “modern” methodology means the returning to the level of development of science that had to be passed many centuries ago? Studying history of evolutionary biology I came to the second viewpoint. It is very difficult to reveal the history of biological thought, because it is always described with the analysis of biographies, social and political conditions, and philosophy. The analysis of interconnected histories does not make clear the evolutionary problems and twists the characteristics of historical processes. For example, crisis and victories of Darwinism are described very often. The first “crisis” was caused by genetics in 1900-1920-s, the second - by new ideas on saltacionism. Analysis of papers on biology demonstrates that during “first crisis” there were a lot of active Darwinists and a lot of Antidarwinists, who did not consider genetics seriously. During the following “period of victory of Darwinism” there were a lot of serious critics of it. Finally, concepts claiming to cause “the modern crisis” do not contradict Darwinism. At least the last 150 years Darwinism, Lamarckism, Orthogenesis, Saltacionism coexisted in evolutionary biology.

Gregory M. Radick *University of Cambridge*

Victorian Society in Darwin’s Theory of Natural Selection

One master narrative in the history of evolutionism goes roughly as follows. Up to the eighteenth century, European societies were static, and people pictured nature

as static. Then came the “dual revolution,” the French revolution and the industrial revolution, after which societies and pictures of nature alike went dynamic. So much is commonplace, and, broadly speaking, uncontroversial. The difficulty lies in the detail. How, exactly, are we to explain this symmetry? I shall explore this issue with reference in particular to the theory of evolution by natural selection. At two points — Darwin’s appeals to Malthusian population pressures and to Smithian division-of-labor notions — Darwin’s theory and the dual revolution intersected. More generally, there is a close and oft-noted match between, on the one side, the social and economic doctrines favored within Darwin’s class, and, on the other side, the Darwinian picture of natural improvement through competition among individuals. The challenge is somehow to explain these connections without explaining them away, and yet without prescinding wholly from the evidence. I shall attempt to meet this challenge by attending to social dimensions of the explanatory constraints under which Darwin worked. I shall suggest furthermore that Darwinism intersected most fully with the dual revolution not in Darwin’s theory of natural selection, but in Galton’s.

David A. Riley *University of Manchester*

”Science Lectures for the People:” Problems in the Public Understanding of Science in 19th Century Britain

This study explores a key development in scientific education for the public given by leading scientists of the third quarter of the nineteenth century, such as T. H. Huxley, J. Tyndall and W. Carpenter, among many others. It is based primarily on a series of their lectures coordinated by Henry Enfield Roscoe, Professor of Chemistry at Owens College Manchester in north west England between 1866 and 1878. Several themes will be explored. Firstly, the links between members of the scientific community throughout Britain and the reasons for their interest in developing public lecturing is investigated. Secondly the public reception of such lecturing schemes and how this developed in Manchester and nationally from the mid nineteenth century is a key focus. Particular emphasis will be placed on the accounts of the Manchester lectures, which appear to be one of the only full published records for this new development. Because they appear to be a verbatim account based on shorthand notes, it is argued that close textual analysis of them (and other local journals and newspapers) can tell us a great deal about the public reception of science at this time the limitations of such analysis will also be examined. Finally the variety of uses this scientific education had will be explored, from concerns over the utilitarian development of the economic base to its relationship with various radical political stances and its philosophical and religious relations.

Colin Russell *The Open University*

Where Science Meets Technology: The Special Case of Chemistry?

During the 20th century chemical history has followed the trend of chemistry itself several decades previously. History of chemistry, once dominant in the history of science, has now been marginalised to the periphery. It has also undergone a strange bifurcation. The chemical history that is being produced is either a highly conceptual study, often

very internalist; or it is an examination of developments in industrial chemistry, with strong social and even environmental emphases. There is little evidence that the two historical communities are much in touch with other, and chemical history thus becomes a classic case of the modern science/technology division, having inherited the weaknesses of such an artificial polarisation. In no other major area of history of science is such a trend so obvious. Yet the major figures in chemistry's long history have, until the quite recent past, been equally at home in pure and applied chemistry. The paper will argue that a decline in the history of chemistry may be reduced by some deliberate bridge-building between the two constituencies. Areas where this is likely to be successful include studies of British academic chemistry in the late 19th century, of German industrial chemistry in the 20th century, and of global attention to chemistry and the environment in our own time and the previous 200 years.

Tom Scheinfeldt *University of Oxford*

Constructivist Historiography: Some Implications for Science Museums

Repeatedly it seems that science museum exhibitions have slighted history. Rather than presenting science as a historically grounded and contingent human pursuit, museums have most often chosen to exhibit science as a linear and positive progression of objects or a set of 'disembodied' or 'transcendent' theoretical principles. This situation has led to recent questions of whether or not science museums can take history seriously. Current developments in the historiography of science, however, seem uniquely positioned to introduce historical perspectives to science museum galleries. Constructivist emphases on instrumental, practical and social contexts as constitutive of science and its history seem to present museums with a fresh opportunity to take history seriously. In both nature and substance, the specific and material concerns of constructivist historiography seem tailor-made for the specific and material medium of the museum exhibition. Moreover, not only is the museum display medium well suited for communicating these new ideas, instrumental, practical and constructivist historiography may also present science museums with the chance to make unique and important contributions to constructivist scholarship in their exhibitions. Just as ethnographic approaches and the experimental reconstruction programme have contributed to a new appreciation of operative knowledge and a deeper understanding of how laboratory practices and material resources interact in the production of natural knowledge, these same constructivist sensibilities, if applied in the practice of the history of science, might allow science exhibitions a similar role as locations in which historians can interact with the materials, practices and settings that are their recent concern. Rather than simply distilling the ideas of written historiography for a popular audience, rather than existing as a location for the secondary conveyance of historical scholarship, these new perspectives may allow museum exhibitions to stand as primary research in their own right.

John A. Schuster and Alan B.H. Taylor *University of New South Wales*

Organising the 'Experimental Life' at the Early Royal Society: The Production & Communication of Experimentally Based Knowledge

Our paper examines how knowledge claims were manufactured and communicated

at the early Royal Society. We approach this problem by means of a novel sort of study of the organizational features and dynamics of the Society—its organizationally sedimented patterns of decision-making and action-taking. This work cuts across attempts by Shapin and Schaffer to characterize “the new Experimental Science” in terms of a new ‘form of life’ which broke with the previously dominant culture of natural philosophical contention. Shapin, Schaffer (and Dear as well) see the Royal Society as having been functionally taken over by this ‘experimental life’. Using three case studies of experimental projects at the Society, we argue that the institution was more complex in its internal workings and that the culture of natural philosophy continued to play through and be played upon within the Royal Society, particularly by dominant actors, such as Boyle and Hooke, who could navigate and exploit the decision/action pathways. We conclude by proposing corrections to Shapin’s concepts of the ‘matter of fact’ and ‘epistemological decorum’.

Anne Secord *University of Cambridge*

Botany on a Plate: The Role of Illustration in Dishing up Knowledge

Increasing attention is being paid to visual thinking and the ways in which scientific illustrations convey knowledge. In this paper I focus on a very particular use of illustrations in the highly visual science of botany during the first half of the 19th century, namely the role of pictures in recruiting new participants in the science of botany. I suggest that, in the largely private scientific world of early nineteenth-century Britain, authors and both popular and university lecturers shared the same problems in making botany simultaneously attractive and scientific. Illustrations played a crucial role in this quest because, for all the evidence of the lavish production of botanical plates in this period, few were able to afford such works. The impact and novelty of illustrations could thus be utilised in introducing novices to the study of botany. However, this use of pictures was contentious, leading to debates over the ways in which words and images constituted knowledge and of the role of pleasure in intellectual pursuits. While recent studies have stressed visual representation as a critical element of science and considered its relation to the written word for conveying information, I shall consider the nineteenth-century preoccupation with the mind and mental faculties in relation to corporeal responses to explain concerns over the role of images and the process of recognition. By considering botanical illustration in this way, I will argue that popular botany in the first half of the nineteenth century was defined by many expert botanists as the means by which private individuals could best be encouraged to extend their well-known aesthetic appreciation and love of plants to an active and participatory pursuit of the scientific practices of botany.

Suzanne Le-May *Sheffield Dalhousie University*

Beyond Popularization: Women Naturalists Exploring Science

Nineteenth-century women naturalists are very often found filling the role of science popularizer. Much historical investigation has been under-taken to reveal the extent and importance of the scientific work of women. Studies of women’s science writings have revealed much about the nature of popular science in this period — its retention

of natural theology interests, its presentation of alternative views of nature, and the importance of such works as educational tools for women, children and the working-class. However, an emphasis on popular texts has led to the misapprehension that most women naturalists were only interested in popularizing others' work. Through a case study of Margaret Gatty (1809-1873) and Eleanor Ormerod (1828-1901), I will show how personal correspondence in the second-half of the nineteenth century reveals an added dimension to the study of women popularizers. Gatty and Ormerod were consummate popularizers, but their interests and ambitions stretch beyond their popular works to their own scientific studies. Such women used their personal correspondence networks to become part of the "professional" scientific community. Through their correspondence they explored and announced their scientific ideas and discoveries and gained reputations that moved them beyond that of popularizer. Exploring correspondence opens a new window on the history of women popularizers, a window that reveals a blurring of strict dichotomies of popular and professional and male and female. In their private correspondence the self-effacing popularizer gives way to the boldly opinionated scientist — a scientist respected by her peers.

Sujit P. Sivasundaram *University of Cambridge*

Probing Bounds: Collection, Natural History, Missionaries, and Pacific Islanders

It is now common to speak of collections and collectors in the history of science, and yet there is some uncertainty about how far these terms can stretch. Is the scientific mode of gathering, naming, classifying, planting, growing and displaying restricted to objects that are inanimate and natural? If an individual is termed a natural historical collector, what relationship does he or she have with the desired collection? In the early nineteenth century at least a dozen Pacific islanders arrived in London. They were on occasion put in cages, portrayed without clothes, and spoken of as wild animals. Most were placed in the protection of the London Missionary Society, whose supporters were keen to win them to the Christian faith. Natural historical themes occurred repeatedly in missionary literature: individuals were seen to be just like trees, for example. The state of the soil and the living waters of the spirit were said to determine spiritual growth. The physical was related to the spiritual. Missionaries may thus be termed as collectors of souls and collectors of natural historical specimens in relation to their attempts to convert the Pacific islanders, as this paper will argue. The boundaries between the inanimate and the animate and the human and the animal were constantly navigated, even amongst the evangelicals. Indeed the founders of the London Missionary Society were in close correspondence with Sir Joseph Banks and consulted him on how best to civilise their wards. Not only do the distinctions between natural history and soul saving appear problematic, then, but also those between men of science and evangelical missionaries.

George Smith *Tufts University*

Newton's *Principia* in the Philosophy Curriculum

From the point of view of those engaged in empirical research, the fundamental problem of doing science is to find ways of turning data into evidence. As the blurb on the new

translation indicates, I regard the *Principia* as “the perfect work for illustrating how science, at its best, succeeds in turning data into decisive evidence.” My talk will describe a full year course I regularly give undergraduates and graduates on the Newtonian revolution. In the first semester we trace the emergence of a set of salient questions in astronomy and mechanics during the century leading up to the *Principia*, especially emphasizing the work of Kepler, Galileo, Descartes, and Huygens, and ending with Newton’s initial discoveries. In the second semester, we read the *Principia* from cover to cover, examining how evidence was marshaled to answer these questions either in the work itself or in its immediate aftermath. The central issue throughout the two semesters is, how did we ever come to have high quality evidence in any science? Newton himself thought he had found a new “more secure” approach to doing empirical science and intended the *Principia* to illustrate it. The best way of grasping this new conception is to read the *Principia* cover to cover in the historical context of the science preceding and immediately following it. The talk will describe the course, how it addresses the problem of making the *Principia* accessible, and why it is appropriately part of the philosophy curriculum.

Michael C. Soller *University of California, Los Angeles*

History, Memory, Emotion: Episodes in American Historical Practice

Historians don’t remember: they read, criticize, sort, dissect, analyze, paraphrase, juxtapose, and contextualize. Normal people remember constantly, though they also distort, falsify, essentialize, and detemporalize. The segregation of history from memory serves an important function in historical practice. Yet memory is “hot,” as one historian told me. Through interviews with history professors and graduate students and readings I have pursued two recurring themes of “memory talk”: historians’ use of memory to explore academic practice, including questions of evidence, audience, and criticism and the connections between emotion and memory. Other fields conduct different memory talk, and I compare uses of memory in psychology, library science, and anthropology, among other fields. The pairing of history and memory allows historians to consider interdisciplinary definitions of emotion and selfhood. But in persisting to view memory as false, individual, and emotional and history as collective, critical, and sober, historians postpone questions about the kinds of knowledge they produce and their own positions as inquirers. Historians of science such as Sharon Traweek and Donna Haraway who have been forthright about such questions recognize that fields pursue not just knowledge but also self-knowledge. I briefly trace the memory/history split through several episodes: the invention of scientific history in England and Germany in the late 1800s the criticism of history, from Maurice Halbwachs and Collingwood at mid-century to anthropologists in the 1970s and 80s and today’s practitioners and the history and science wars of the early 1990s.

Richard Sorrenson *Indiana University*

Matter matters: Or How to Nullify the Peculiarities of the Material World

Eighteenth century instrument makers took a central interest in the peculiarities of the materials they worked with since to make instruments that were not themselves particular or variable but rather universal and invariant, they had to measure the

precise nature of the relevant material variation and design an instrument that eliminated (or severely reduced) it. That is to say, they had to understand matter in order to nullify one of its inescapable characteristics: variability. To do so they designed new instruments - of which I shall investigate two, the pyrometer and the vitrometer - to measure matter's variance. These instruments are analogous to machine tools (machines that help make machines) since they are instruments that helped make instruments, but they also indicate the subtle understanding of nature and artifice that instrument makers possessed. It took hard work to overcome the variances of particular pieces of matter and construct instruments that then demonstrated that nature was, under the right conditions, invariant.

Emma Spary *Max-Planck-Institut für Wissenschaftsgeschichte*

By Design: Shell Prints and an 'Aesthetics' of Scientific Illustration in 18th-Century Europe

This paper might be described as an experiment in historical seeing. By looking in detail at one scientific genre, the eighteenth-century conchological work, I want to explore the relations between texts which purport to capture the true nature of Nature, and the genres and styles of illustration of natural objects. My aim is to break with those existing historiographies of the scientific illustration which assert either that we cannot 'read' scientific images at all, or that images of natural objects are transparent representations of the natural which do not need to be explicated. I shall focus upon a particular tradition of European conchological publications between the 1730s and the 1780s, which subsequently became discredited as being too artful. I will suggest that the tools for writing a history of scientific illustrations can be acquired from the writings of reception theorists and historians of the book about the fashioning of a community of competent readers, as well as discussions of the interpretation of visual images by semioticians and sociologists of knowledge.

David A. Steinberg *Saa Institute*

Concomitance and Complementarity - Common Paths to a Modern Science

John Hughlings Jackson (1835-1911), the creator of scientific neurology, invoked what he termed a doctrine of concomitance to explain the relationship between mutually exclusive evolutionary structures of brain and mind. Though he ultimately rejected the most general form of this relation, it contains the implicit notion that mind and brain are two manifestations of a single unknown process. In 1925, the mathematical structure of non-relativistic quantum mechanics was completed, superseding the empirical observations and ad hoc assumptions of the old quantum theory. It was quickly realized that this formalism contained significant interpretive difficulties. An attempt to resolve these problems led Niels Bohr (1885-1962) to formulate the notion of complementarity in which a quantum mechanical description manifests itself through a pair of mutually exclusive classical ideas - e.g., particle and wave. The close congruence of these two organizing principles - one forming the basis of modern neuroscience, and the other the basis of modern physics - is remarkable. This study will explore the similarities, and raise the question of whether the ideas of concomitance and complementarity are specific examples of a more general principle that can be applied in the history of science.

John Suppe *Princeton University*

**The Tandem Bicycle Ride: Exponential Growth of Science and the Academy
in the 19th & 20th Centuries**

The exponential acceleration of scientific activity—doubling in geometric progression like compound interest—has been widely observed since the pioneering work of Derek Price in the 1950s. For example, the rates of publication and the numbers of journals, authors, PhDs and even astronomical observatories and known chemical compounds have shown remarkable exponential growth since the 19th century or before. However not all instances of exponential growth show the same dynamics and intrinsic or extrinsic causes. New subdisciplines, research programmes, or revolutions typically show very rapid exponential growth, often triggered by specific events, and lasting for at most a few decades followed by saturation. The doubling times have been as short as a few years or less, often with a strongly intellectual impetus for growth. Examples of this rapid growth and saturation include the glacial, plate tectonic and string revolutions and the subdisciplines of isotope geochemistry. In contrast the larger disciplines that form academic departments, such as physics, geology or mathematics, have grown at more modest exponential rates that have been relatively constant for the last two centuries. It is perhaps less widely appreciated that non-scientific academic disciplines show the same long-term exponential growth as science. It is remarkable that the rates of publication in history, philosophy, physics, geology and mathematics show nearly identical exponential growth for most of the nineteenth and twentieth centuries, except for short-term transient differences. This observation shows that the dominant long-term controls on the growth of scientific activity must be strongly linked to those of the academy as a whole. The causes of this linkage and growth will be discussed. We are all academics on a tandem bicycle ride.

Philip M. Teigen *National Library of Medicine*

Language, Logic, and the Historiography of Medicine

Historians and philosophers of science tell us that theory choice is often underdetermined, meaning that theory choice is not based exclusively on observations of nature. In short, the facts don't speak for themselves. If scientific theories are underdetermined, then, surely historical narratives and theories are also. Indeed, using another conceptual framework, Hayden White argued this point in *Metahistory: The Historical Imagination in Nineteenth-Century Europe* (1973). What lies between the reservoir of sources that historians of medicine draw upon and the products of their research? It is the operating system humans use to create and interpret discourse, otherwise known as Rhetoric. Almost all medical historiography is devoted to sources and subject matter few scholars have explored the logic and language of medical history. The reasons most are reluctant to do so are several, including three treated here: 1) confusion about the nature and applicability of theories of reading and writing to historical productions 2) fear that such exploration will distract from the main business of producing specialized research 3) fear that the

acknowledgement of a rhetoric of medical history will undermine the authority of historical accounts. After arguing that there are beneficial reasons for including rhetorical analysis in traditional historiography, I conclude by pointing out that Leopold von Ranke (1795-1886)—whose institutionalization of historical study in the university and promotion of archival research revolutionized historical scholarship—explicitly drew upon rhetorical theory in promulgating his classic statement about the nature and purpose of the historical enterprise.

Paul Theerman *NLM/Digital Manuscripts Program*

Profiles in Science: Biomedical Research in the Twentieth Century

Through its Profiles in Science project, the National Library of Medicine (NLM) is making available on the World Wide Web the archival collections of pioneering biomedical scientists of the twentieth century. The collections—so far comprising the papers of Nobel prize winners—have been donated to NLM and contain published and unpublished items, including books, journal volumes, pamphlets, diaries, letters, manuscripts, photographs, audio tapes, video clips, and other materials. These are digitized, mounted, and made available through a number of different modes of access. The site was launched in September 1998 with a selection of papers devoted to the life and work of Oswald T. Avery (1877-1955). Subsequent additions have been: the papers of Joshua Lederberg (b. 1925), March 1999; the papers of Martin Rodbell (1925-1998), November 1999; and the papers of Julius Axelrod (b. 1912), May 2000. Planned for the web in November 2000 are the papers of Christian Anfinsen. The digital collections on the Profiles site consists of an introductory historical exhibit and hot links to images of documents (text, graphic, and motion picture) with metadata (roughly, catalog information) about each one. In addition, access to a larger universe of images is available through a search engine and in alphabetical and chronological “views.” For the Joshua Lederberg collection, the donor has also provided commentary in the form of annotations to individual documents. Planned for the future is to provide access to the documents using the hierarchical structure and arrangement of a traditional archival finding aid. Profiles in Science is a research product of the digital library research program at NLM’s Lister Hill National Center for Biomedical Communications, in collaboration with the Digital Manuscripts Program of the library’s History of Medicine Division. Profiles in Science is found at <http://www.profiles.nlm.nih.gov>. This session will introduce Profiles in Science, show how it is structured and used, sketch out plans for its future development, and gather reactions from the audience on this mode of historical presentation and access to primary materials.

Carsten Timmermann *CHSTM, University of Manchester*

‘Folk Knowledge’ and Professional Politics: Medical Historians and Popular Science in Inter-war Germany

For historians of western medicine in the last few decades, writing on professionalisation and the authority of medical experts was a way of dealing with the power structures of the postwar world. Is this still necessary at the dawn of the

new millennium? Today, ethics commissions and malpractice suits increasingly curtail the autonomy of medical professionals. With “alternative” and “complementary” therapies more popular than ever, it seems as if patients are rapidly regaining the right to their own bodies. Issues of choice (and regulation) are becoming increasingly important. And informed choice presupposes enlightened consumers. What could be our function as historians in all this? Historians usually contribute to political debates either by suggesting analogies with the past (and pointing out differences) or by seeking to uncover the roots of a current situation. By exploring the attitudes of interwar German medical historians towards popular science, in this paper I will follow the first path. Weimar Germany experienced an explosive rise of medical alternatives—homeopathy, biochemistry, naturopathy and others—all organised in large lay societies. These societies saw the education of the population in health matters as part of their mission. Representatives of the medical profession, however, dismissed all non-licensed healers as quacks, and their activities as illegitimate. My paper examines the roles of contemporary medical historians in these conflicts, their contributions to the debate and their positions on issues of choice and popular knowledge. While some historians argued for extensive health education of the public, others denounced it as “profanisation.” Studying Weimar medical culture, how it differed from our present situation and how it was similar, may help us to understand our own role today.

Jonathan R. Topham *University of Leeds*

Religious Practices and the Uses of Scientific Books

Over recent years, historians have taken the practice of science increasingly seriously, leading to major historical revisions in a number of areas. By contrast, historical discussions of ‘science and religion’ are still often dominated by consideration of predominantly propositional beliefs of theological and scientific kinds. The object of this paper will be to demonstrate the value of exploring religious practice for understanding the place of science in the religious culture of early nineteenth-century Britain. In the burgeoning world of print in this period, a far wider range of readers encountered scientific material than ever before. For many, however, such material was read and encountered primarily within the context of religious practice. In this paper I will explore some of the ways in which reading science was incorporated into the diverse practices of Christian devotional life. The discussion will draw in part on the various forms of reading advice and instruction available in the period, from conduct manuals and periodical reviews to sermons and addresses. This will be complemented by materials relating to individual reading experiences, drawn from diaries, letters, and autobiographies. By focusing on the practices of reading and of Christian devotion, the paper will highlight the extent to which scientific material was valued or feared not so much for its propositional content, as for its effect on religious feeling. That this was so undermines the traditional historiographical emphasis on the importance of a propositional natural theology, and indicates instead the importance of a variety of discourses about nature which were considered useful in engendering religious sentiments and sensibilities in readers.

Jonathan R. Topham *University of Leeds*, Geoffrey N. Cantor *University of Leeds*,
and Gowan Dawson *University of Sheffield*

Science in the Nineteenth Century Periodical: Demonstration of the SciPer Database

The Centre for Nineteenth-Century Studies at the University of Sheffield and the Division of History and Philosophy of Science at Leeds University have joined forces to mount the SciPer [Science in the Nineteenth-Century Periodical] project. This project aims to identify and analyse the representation of science, technology and medicine, as well as the inter-penetration of science and literature, in the general periodical press in Britain between c.1800-1900. This highly interdisciplinary project addresses not only the reception of scientific ideas in the general press, but also examines the creation of non-specialist forms of scientific discourse within a periodical format, and the ways in which they interact with the miscellany of other kinds of articles found in nineteenth-century periodicals. The periodicals to be indexed include not only such mainstream titles as the *Edinburgh Review* and the *Cornhill* but also examples of satirical, denominational, radical, women's and children's periodicals. The project's primary objectives are, firstly, to produce a series of analytical essays which will consider the portrayal of the sciences within the general periodical literature of nineteenth-century Britain, and, secondly, to publish a searchable electronic index which will enable researchers engaged in a broad range of historical and literary searches of a scientific content of the indexed periodicals. Although the electronic index will not be published until early 2002, a prototype containing a limited range of titles will be demonstrated at the St. Louis meeting. Historians of science will thus be able to appreciate the potential of this new and exciting research tool. See also the SciPer web site: <http://www.sciper.leeds.ac.uk>

Ellen Valle, *University of Turku*

A Collective Intelligence: Aspects of discourse in 18th and 19th-century writing in the life sciences

I report the findings of a study applying methods of linguistic discourse analysis and pragmatics to a longitudinal corpus of writing on the life sciences (medical science and natural history) published in the *Philosophical Transactions* of the Royal Society. The total corpus consists of 200 texts, published in 1665, 1765, 1865 and 1965; in the paper, I focus on the texts from 1765 and 1865. I discuss the global generic structure of the texts and some local, detailed aspects; in particular ways in which other, non-authorial voices are inserted into the text. In 1765, more than a third of the texts are epistolary in form. Of these, some are 'genuine' letters sent for instance from North America, while others are 'fictional', making use of a generic convention. A number of texts consist of multiple layers of correspondence, all of which are visible in the published version, without editorial or authorial framing. In 1865, epistolary framing has disappeared: all texts are presented as authorial articles. The only exceptions are a few texts in which letters or excerpts from letters are embedded. These represent the persistence of an older tradition: a collective intelligence based on contacts and co-construction among a personal and private or semi-private

community. The result is published, in part, in the *Philosophical Transactions*, where a broader community is allowed to overhear it. The new community, already dominant in 1865, is public, and is anchored in a published and generally accessible literature. The findings suggest, on the one hand, that the transition took place relatively late; in the 1810s, the epistolary genre and the use of personal references rather than citations are still unexpectedly strong. This can plausibly be seen as part of the general scientific culture in the Royal Society at the turn of the century, under the Banks presidency. Secondly, there are a number of ways in which writing in the life sciences in the high Victorian era of the 1860s stands out from both earlier and later periods. In the paper, I discuss four such dimensions:

1. The voices represented in the text: e.g. the authorial voice, a specified or unspecified other voice, or the community as a whole.
2. the structure of reported discourse in citations; more specifically, the extent to which the reported discourse is controlled by and subordinated to the authorial voice.
3. the rhetorical functions of citations.
4. the occurrence of ‘hedging’ and ‘face-saving’ forms of discourse in the texts in cases where the author disagrees with or rejects the ideas reported.

Taken together, the outcome of the study suggests that by the 1860s, the older tradition of writing which began in the 17th century, based on a relatively private, personal discourse community, and with its own forms of gentlemanly courtesy and face-saving, has come to an end; new ones, however, have not yet completely emerged. The individual authorial voice is all-powerful, the voice of the community is relatively weak, and courtesy is in many cases conspicuous by its absence.

Steven A. Walton *University of Toronto*

Thomas Hood and Armada Angst: How Mathematical Were the Military Sciences?

In 1588 when Thomas Hood addressed his audience as the Mathematical Lecturer for the City of London, the Spanish Armada loomed large in all his listeners’ minds. So, not surprisingly, when Hood enumerated the benefits of the mathematical lectureship, military utility ranked high on his list. But this belief — that mathematics would directly benefit the military — was not inspired by the Armada. John Dee had noted as much in his *Mathematicall Praeface* nearly two decades before. And by the turn of the century, everyone seems to have tacitly agreed that the military was one of the logical places of employment for the mathematical practitioners. When historians of science have looked at the mathematical practitioners, they have silently taken up this assumption and called the military sciences tacitly mathematical in the late 16th century, and even pushed it back to the early 16th century. Here I want to consider just what it was that was “mathematical” about warfare in the later 16th century. In particular, a survey of some of the English cases of men interested in the military and interested in the mathematics allows us to reconsider the mathematization of warfare. In the end, I suggest that war was not so much mathematized as “arithmeticized,” suggesting that simple quantification, not the more impressive theoretical understanding (which did characterize other professions in which the mathematical practitioners found work), was the goal.

Deborah Jean Warner *Smithsonian Institution*

"I never intend to wrap my Talent in a Napkin": Benjamin Franklin as a Man of Achievement

Steven Shapin has described Robert Boyle as the paradigmatic experimental philosopher one whose reputation for speaking the truth was based, in large part, on his aristocratic birth, extravagant wealth, and Christian piety. Other factors that contributed to Boyle's trustworthiness included chastity, frailty, and dislike of fashionable society. And then there was his modesty. In Shapin's words, a man who would be seen as a scholar and a gentleman "should not seek egotistically to celebrate himself...but modestly to detach knowledge from the self that produced it." Shapin further suggests that Boyle's "philosophical identity continued [to be] a usable template" well into the 20th century. Portraiture, however, suggests otherwise. That is, many men of science, even in England, did not fit their public image to Boyle's template. In this paper I will examine the three "electric" portraits of Benjamin Franklin that proclaim a celebration of self, and identify the accomplishments that raised Franklin from obscurity to fame. Each shows Franklin as a vigorous and well-fed man comfortably ensconced in his study, apparently content with his merchant-class status, and pleased with his mastery of the science and technology of lightning. This form of portrait a person with the specific tools and/or products of his/her achievements may have begun with medieval depictions of saints, but became especially common with the opening of secular avenues of achievement in the 18th century. Natural philosophers and mathematical practitioners were often depicted in this way, but so too were as artists, authors, antiquarians, and other achievers. This suggest that historians of science might do well to regard 18th century "men of science" within the larger framework of "men of achievement."

Michael P. White *McGill University*

Modern Times: Temporality and Modernity in Charles Lyell's *Principles of Geology*

If recent scholarly interest in Charles Lyell can be said to have a common aim, that aim would most likely be, in Michael Bartholomew's words, "to push Lyell out to the margins." Far from occupying his previous status as the harbinger of modernity in the guise Darwinian evolution, radical historicism and modern geology, he now appears as an isolated and problematic figure. Discussions of his significance often seem to be as specific as they were previously broad. Lyell is now reduced to the "supreme anthologizer," an adherent of pagan cyclical cosmology, a Newtonian synthesizer, or the last great Enlightenment "armchair theorist." Yet, Lyell's *Principles of Geology* (1830-33) remains an important document of abiding intellectual interest because of its complex and contradictory representation of an immense time frame for earth history. In the wake of recent scholarship in the history of science in Britain, scholars such as Stephen Gould and Rachel Laudan, have characterized the significance of Lyell's "deep time" as an idiosyncratic function of his obsession with methodological and narrative unity. I argue, to the

contrary, that the cultural significance of Lyell's temporal outlook can better be understood in the complex combination of a variety of contemporary temporal frameworks rather than as a sterile advocacy of the "deep time" of geological science. By examining his superimposition of a variety of temporal registers not usually associated with Lyell's text, and which comprise the futuristic as well as the retrospective orientation of modernity, (eschatological, pagan, and geological), Lyell's *Principles* can be thus be understood as a site of intersection for the multiple and contradictory temporalities organizing British society during the period surrounding the publication of *Principles of Geology*.

Paul S. White *University of Cambridge*

Passion for Science: The Display of Feelings in Late-Victorian Biology

Recent studies in the history of objectivity, instrumentation and scientific discourse have traced the gradual effacement of the emotions from scientific practice over the course of the 19th century. This trajectory, which follows long-standing accounts of the emergence of the modern scientific profession, needs substantial revision. What I provide, instead, is an account that suggests the enduring importance of various forms of feeling, both in the public presentation of scientific research, and in the constitution of scientific community. In this paper, I discuss a public debate over the nature of feeling and its place in the experimental life sciences and medicine in late Victorian Britain. Following from concerns over the practice of animal experiment, a critique was mounted against physiologists and their scientific supporters by high-political, high-church, and literary figures, and by members of the medical profession. The critique focussed on the scientific practitioner as a master of feelings, especially the tender affections of sympathy, compassion, sorrow and pity, feelings widely held to be the highest forms of human nature, and crucial marks of distinction between human and beast, feelings that were possibly obliterated in the process of scientific training and discipline, thus rendering practitioners heartless machines or monsters. Physiologists and their defenders worked to legitimate themselves on several fronts: they publicly demonstrated the physiological basis of feeling in lower mechanical and instinctual processes, they exhibited their concern for animals through the use of anaesthesia and other pain-saving technologies, and they displayed their feeling for humanity through the sacrifice of their own health and life in the battle against disease.

Roland Wittje *Norwegian University of Science and Technology*

Scientific Instruments as Source Material for History of Late 19th- and early 20th-Century Physics

History of experimental physics can make good use of scientific instruments preserved either from a certain experiment or from the relevant era in general. They may supplement written texts, photography and/or oral histories on a particular subject. As relics of scientific practice in past times, they often tell a story by themselves. They can also serve to offer a valuable new perspective on other source material. Interpreting surviving instruments, however, is not as established in history of science as other types of sources are. As with all forms of research the interpretation of

surviving scientific instruments comes with its own strengths and difficulties. I propose to draw Hertz' experiments on electromagnetic waves, as well as early 20th century lecture demonstration instruments and a Van de Graaff particle accelerator built in Norway in the 1930s as examples for how remaining instruments contribute to research in history of physics. The instruments in question have often undergone various modifications and other changes during their period of use. A timeline of modification can often be discovered after a close study. Of course, this indicates that we cannot assume an existing piece of equipment to be in its original condition but rather in the state it was when it was put out of use. There are also examples of instruments being considerably altered after coming into possession by a museum or another collector. To learn from a particular instrument, one must often use either with original or the copy in a performance. This can imply everything from testing proposed modes of function to repeating experiments.

Katharine Wright *University of Toronto*

Humanism, Antihumanism, and Technoscience

Scholars in science studies have recently turned their attention to humanism as a way to understand developments in twentieth century science. In doing so, they are joining a debate about the nature and meaning of humanism that has been going on with particular force since the time of Heidegger. But historians of science tend not to acknowledge this rich intellectual history in their work, resulting in the impression that the humanism/antihumanism debate arises from the development of science and technology alone. I will outline the history of the concept of humanism in the twentieth century, with attention to critical figures such as Heidegger, Sartre, the poststructuralists, and the contemporary political philosophers who are attempting to revive humanism. That history will place recent history of science in a new light, notably Andrew Pickering's work on technology and social theory and N. Katherine Hayles's work on the history of cybernetics, both of which advocate posthumanism as a way to transcend the humanism/antihumanism debate. But it is not clear that this is a straightforward solution. The stakes in the humanism/antihumanism debate are high, and I will show that this extends to that small part of the debate that is going on in history of science and science studies.

Ibrahim Yaseen *Mansoura University*

Sources of Science: "Egyptian Origins"

Attention has been drawn again to the thesis that science owes a great deal to Egyptian civilization. Martin Bernal's study, "Black Athena," and Gorge G. James "Stolen Legacy" are two of the most distinguished books in dealing with this thesis. Joining their ranks, Anthony Preus has reconfirmed the idea that Egyptian thought anticipated the theories propounded by Greek philosophers from Thales to Aristotle, furthering the notion that Egyptian culture and sciences seemed stolen by the Greeks. My major objective in this paper is to investigate the sources of science and to determine the influence of Egyptian thought on Greek philosophy and sciences. It is well known that the Greeks were always open to Egyptian inventions: for example, in *The Odyssey* Helen is represented as having learned Medical Arts in Egypt. In

The Mythology too, readers find similarities between Greek and Egyptian thought. In fact, the strongest part of Bernal's work is his thesis that Pythagoras' philosophy and the theory of the soul (Metempsychosis) in the *Immortality of the Soul*, as well as his mathematizing theory of the universe, originated in Egypt. In this paper, I make the following preliminary arguments: (1) I agree with Anthony Preus and Cristos Evangeliou that Pythagoras could have learned practical geometry in Egypt; (2) the theory of numbers and Mysticism seem to have been Egyptian in origin and were fundamental concepts for the Pythagoreans; (3) strong interest has been devoted to political theories that depended on Egyptian practices; and (4) as G. James points out, Democritus, who harmonized the Greek and the Egyptian calendars, is said to have studied Mathematics in Egypt. Democritus was also aware of the theory of the Egyptian "Atom" and imported it into Greek thought.

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