

HISTORY OF SCIENCE SOCIETY

2000 ANNUAL MEETING

PHILOSOPHY OF SCIENCE ASSOCIATION

2000 BIENNIAL MEETING

2-5 November 2000
Vancouver, British Columbia, Canada
Hyatt Regency Vancouver

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Cover Illustration: SeaBus riders get the best view of Vancouver from the water. Offering regular service on the busiest routes from 5 a.m. to 2 a.m. and late night owl service on some downtown suburban routes until 4:20 a.m., Greater Vancouver's transit system--the bus, SkyTrain and SeaBus--covers more than 1800 square kilometers (695 square miles) of the Lower Mainland. The SkyTrain, a completely automated light rapid transit system, offers direct, efficient service between downtown Vancouver and suburban environs. It follows a scenic elevated 29 kilometer (18 mile) route with 20 stations along the way. All the SkyTrain stations, except Granville, have elevators and each train is wheelchair accessible. The SkyTrain links with buses at most of the 20 stations and connects with the SeaBus in downtown Vancouver. It operates daily, every two to five minutes. The SeaBus is a unique, passenger-only, wheelchair accessible ferry service that connects Vancouver from Waterfront Station with Lonsdale Quay on the North Shore. The scenic crossing of Burrard Inlet takes 12 minutes and covers two fare zones. It's the only marine bus system of its kind in the world. Bikes are allowed. TransLink Vancouver has wheelchair lift equipped or low-floor buses on 78 routes. New routes are introduced every year. Accessible buses and bus stops are identified by the international wheelchair symbol, while the letter "L" identifies the schedule service in public timetables. Photo courtesy of <http://www.HelloBC.com>.

Printed in the USA.

HSS ACKNOWLEDGMENTS

Much excitement has accompanied the Vancouver meeting since the site was announced several years ago. Prior meetings on the west coast, in Seattle and in San Diego, were heavily attended, and this will be true for Vancouver, as we expect almost 1000 delegates for the 2000 meeting. The popularity of the largest city in British Columbia became evident early on as evidenced by the reception of a record number of session and paper proposals. The HSS was extremely fortunate to have the likes of Tom Broman, Lynn Nyhart, and John Harley Warner—HSS program chairs—to assemble and shape the many HSS submissions into a program that has generated countless comments on its breadth, depth, and intellectual quality. The Philosophy of Science Association, received a similar response from its members, and the PSA program chair, Jeff Barrett, has organized this large number of proposals into a dynamic program. The conference will begin on Thursday afternoon with the first PSA sessions and will continue through that evening with the HSS plenary session and a special reception at the Museum of Anthropology. The museum reception has proven so popular that tickets were sold out almost six weeks before the event. We wish to offer a special thank you to the President's Office of the University of British Columbia for their sponsorship of this event.

Many individuals and groups have worked to bring this meeting together. Site selection and preparation were handled by Keith Benson and our local organizer, Stephen Straker, who was the driving force behind the museum reception. George Gale, Executive Secretary of PSA, has worked tirelessly to help tie together the many loose strings that always accompany such meetings, and Jeff Barrett has proven to be an exemplary chair. The staff in the HSS Executive Office, which has handled all the registrations, program printing, requests, and thousands of other details, has been a real pleasure to work with. My special thanks to Gail Alexander, Carson Burrington, Melissa Oliver, and Ben Stenberg.

Robert J. Malone
HSS Executive Director

PSA ACKNOWLEDGMENTS

I would like to thank the members of the PSA Program Committee and the referees who helped us for their excellent work. I would especially like to thank Jason Alexander (University of California, San Diego), who assisted in the construction of the PSA program at every step.

Jeffrey A. Barrett
PSA Program Chair

HSS OFFICERS, PROGRAM CHAIRS AND COUNCIL

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GOVERNING BOARD OF THE PSA

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Alison Wylie
Washington University, St. Louis

GENERAL INFORMATION

REGISTRATION: Registration will take place in the Regency Foyer on the conference level of the Hyatt Regency (near the escalators), on Thursday 2 November from 2:00 p.m. to 7:00 p.m., Friday 3 November from 8:00 a.m. to 5:00 p.m., and Saturday 4 November from 8:00 a.m. to 2:00 p.m.

PROGRAM CHANGES: Please note that certain modifications have been made in the program since its publication in the July *Newsletter* and its appearance on the HSS Web site. Session organizers have been informed of scheduling changes, and are held responsible for contacting panel members regarding such changes. Please confirm the date and time of the session in which you are participating. Any last-minute changes in the program will be posted at the registration table.

HOTEL INFORMATION: The 34-story Hyatt Regency Vancouver features 644 guest rooms. Check-in time is 4:00 p.m. and check-out time is 12:00 p.m. The recreational amenities include an outdoor, heated swimming pool, and a fully equipped health club with treadmills, Stairmaster®, Universal® fitness machines, and Lifecycle® and Nautilus® fitness equipment. All meeting rooms offer individual or master controls for heat/AC, sound and music, and telephones. Four restaurants and lounges are located within the hotel, including *Fish & Co.*, the Hyatt Regency Vancouver's signature restaurant. Conveniently located downtown, the Hyatt is adjacent to exclusive shopping in Royal Centre, two blocks from Pacific Centre and Robson Street, sports complexes and theatres, and convenient to 1000-acre Stanley Park, Granville Island and Grouse Mountain, Canada's largest aerial tramway for skiing and recreation. The Hyatt is 20 minutes to the Vancouver International Airport.

TRANSPORTATION INFORMATION: Door-to-door shuttle service from the airport to the hotel is available from The Vancouver Airporter Shuttle for \$17.00 Canadian round-trip. Taxi service is also available. Please contact the hotel concierge or reservations desk for assistance in arranging for airport transportation—remember that the shuttle service will be busiest Sunday morning. Discount coupons for the airporter are available at the Registration Desk.

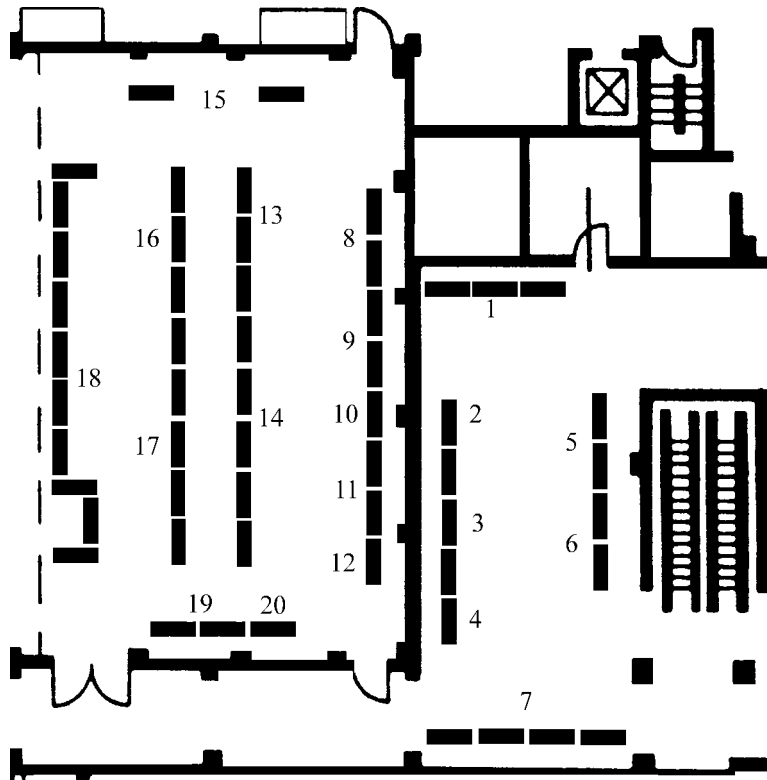
BOOK EXHIBIT: Select publishers will exhibit current titles in the history and philosophy of science throughout the course of the conference. The book exhibit will be in the Regency Foyer and the Regency East of the Hyatt from 8:00 a.m. to 5:00 p.m. on Friday, 3 and Saturday, 4 November, and from 8:00 a.m. to 12:00 p.m. on Sunday, 5 November. Tables, chairs, coffee and tea will be provided near the exhibit area for informal meetings and/or relaxation between sessions. Please direct all questions regarding the display to Benjamin Stenberg, Exhibit Coordinator.

HSS / PSA 2000 ANNUAL MEETING BOOK EXHIBIT LAYOUT

Regency East and Foyer

Friday, 3 November
Saturday, 4 November
Sunday, 5 November

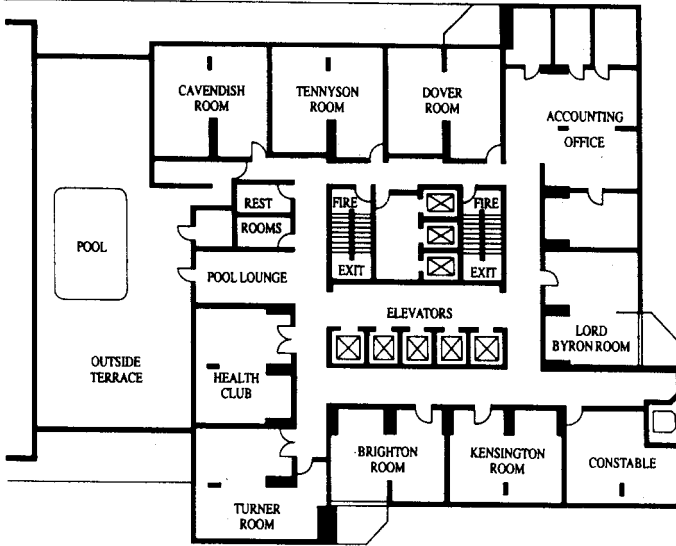
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8:00 a.m.—5:00 p.m.
8:00 a.m.—12:00 p.m.



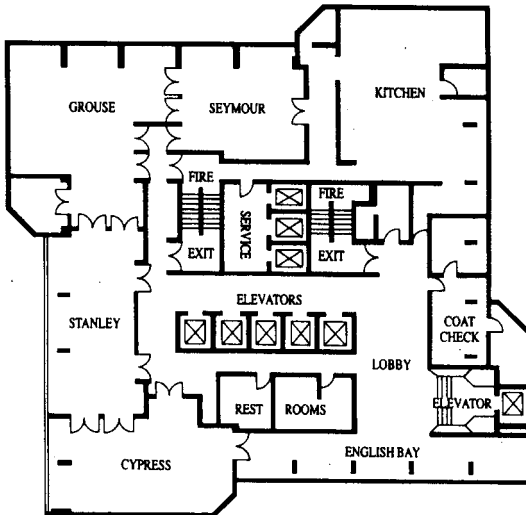
- | | |
|---|-------------------------------------|
| 1. Registration | 11. MIT Press |
| 2. Science History Publications | 12. Chemical Heritage Foundation |
| 3. Kluwer Academic Publishers | 13. Rutgers University Press |
| 4. Science in the 19th Century Periodical | 14. Cambridge University Press |
| 5. Johns Hopkins University Press | 15. Coffee Stations |
| 6. Green Lion Press | 16. Institute of Physics Publishing |
| 7. Combined Book Exhibit | 17. The Scholar's Choice |
| 8. Harvard University Press | 18. University of Chicago Press |
| 9. Ashgate Publishing Company | 19. B&L Rootenberg Rare Books |
| 10. University of Pittsburgh Press | 20. Blackwell Publishers |

FLOOR PLAN: HYATT REGENCY VANCOUVER

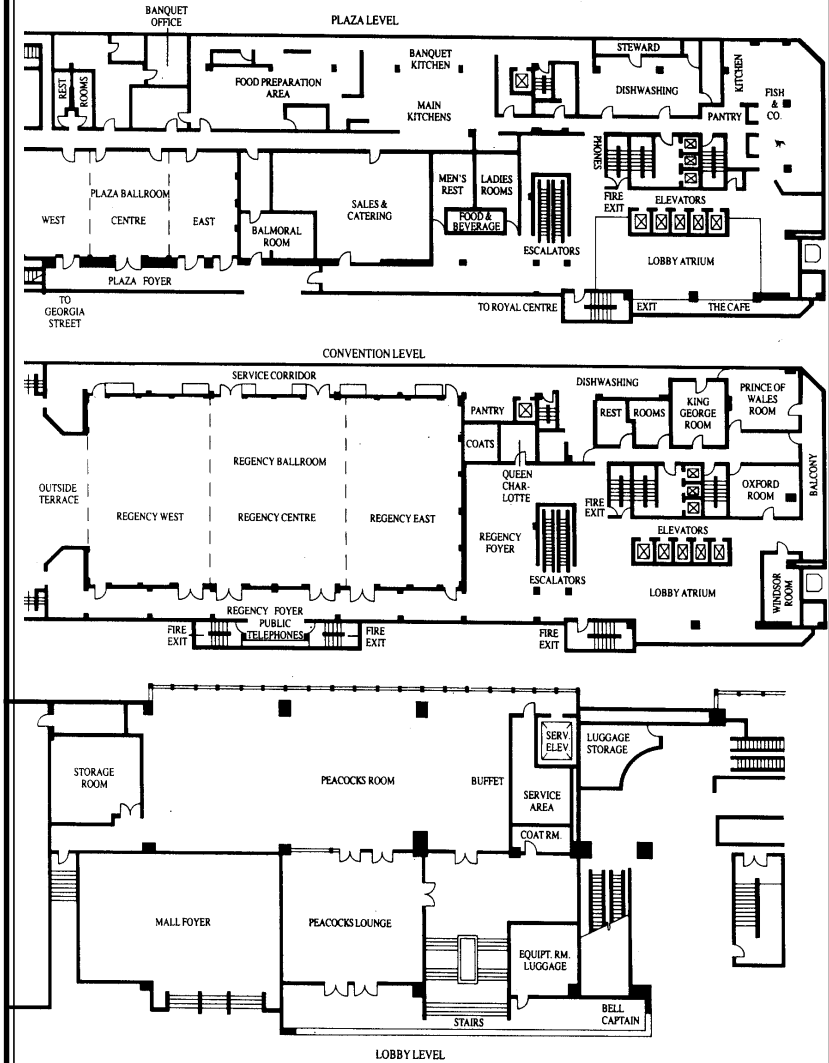
FOURTH FLOOR



PERSPECTIVES LEVEL



FLOOR PLAN: HYATT REGENCY VANCOUVER



VANCOUVER POINTS OF INTEREST

Over 200 years ago Captain George Vancouver arrived at the site that would eventually bear his name; his project was to carefully map the area between Oregon and Alaska. In the interim since his arrival, the city of Vancouver has blossomed into one of the premiere cities of the Pacific Rim. It boasts an international profile and a diverse cultural heritage; it has the largest and busiest port in Canada and on North America's west coast; it prides itself on maintaining a clean and safe downtown with a cosmopolitan shopping area; and it provides the visitor with ample leisure opportunities. In March 1995, the Corporate Resources Group in Geneva, Switzerland, ranked Vancouver as the second best city in the world—the best in North America—based upon living and environmental conditions; 118 cities were considered. In December 1997, the same group rated Vancouver as the most livable major city in North America and the world. As for Canadians, they voted it the “Most Beautiful City in Canada” in its category (population over 300,000) in 1999. In addition to these honors, Vancouver is the most accessible city in the world according to the publisher of *We're Accessible*, a newsletter for travelers with disabilities. The city boasts over 14,000 sidewalk wheelchair ramps and an extensive public transit system designed to accommodate persons with disabilities. Unlike many North American cities, Vancouver is a people place.

The hotel for the annual History of Science Society Meeting, the **Hyatt Regency Vancouver**, is located on the western edge of the downtown core. Downtown Vancouver includes the area between Burrard Street on the west, False Creek on the south, Vancouver Harbour on the north, and from the corner of Cordova and Granville to Science World, on False Creek on the east. Vancouver's downtown is surrounded by water on three sides and you can walk along the water around almost the whole of downtown. The area is not large, and for any person on foot and in relatively good condition, it can be crossed in less than an hour. For individuals not wishing to walk, but wishing to see some of the sights of the area, the Canadian designed **ALRT** (Advanced Light Rapid Transit)—SkyTrain—can be used. All rapid transit stations are equipped with self-serve fare machines, and tickets purchased at them are good for bus and SeaBus travel, as well; conversely, transfers from the bus can be used on the SkyTrain.

Whether by foot, by rapid transit, or by car, Vancouver has a multitude of things to see and do. West of the downtown core, is Vancouver's beautiful **Stanley Park**. At 1000 acres, it is the largest urban park in Canada, the third largest in North America. Entrance from downtown Vancouver is via the west end of Georgia Street. A five and a half mile seawall path completely encircles lush green rainforest, pristine lakes and grassy meadows. Walking at a brisk rate, one can take little time to admire the English Bay beaches and the collection of totem poles at **Brockton Point**. In the mood

for a shorter walk? Consider strolling around **Lost Lagoon**. The lagoon, located at the Georgia Street entrance, is home to a variety of waterfowl including swans, ducks and Canada (not Canadian) Geese. As well, a number of smaller paths infiltrate the woodland that forms the core of the park. From these, one can find impressively large cedar, hemlock and fir trees. At the **Vancouver Aquarium Marine Science Centre** in Stanley Park, get personal with beluga whales in a unique animal encounter program. Just over one hundred years ago, an English sea cannon was placed in the park. **The Nine O'clock Gun** was used to remind local fisherman of fishing time limits. It is now used as a time signal, and can be heard at nine o'clock every evening by anyone in or near the park.

For those individuals interested in neither wandering through the park nor venturing far from the hotel, the downtown core has a great deal to offer. A myriad of architectural wonders, noteworthy museums, great food, and shopping can be found by taking either a short walk from the Hyatt Regency Hotel or a quick trip on the SkyTrain (the Burrard Station at Burrard at Dunsmuir Street is adjacent to the Hyatt Regency Hotel in downtown Vancouver).

At the northernmost end of Burrard Street, on Waterfront Street is **Canada Place**. Built to resemble an ocean liner with luminous white sails, Canada Place is a Vancouver landmark. Established as the site of the Canada Pavilion for EXPO 86, Canada Place was built upon a former cargo pier; since EXPO 86, it has become home to shops, restaurants, a cruise ship terminal, the Pan Pacific Hotel, the Vancouver Trade and Convention Centre, a World Trade Centre office complex, and the **CN IMAX Theatre**. The latter with its five-story-high screen and wraparound IMAX Digital Sound puts the viewer in the picture like no other movie format can.

South of Canada Place, at the intersection of Burrard and Hastings, stands a monument to the art deco movement. The **Marine Building** opened in 1930 and had the distinction of being the tallest building in the British Commonwealth for a decade after it opened. While it no longer holds that distinction, it is still worth seeing. Inside and out, delicate carvings and sculptures in terra cotta, brass, stone and marble emphasize a marine and transportation theme.

Further south and over two blocks are **Robson Square** and the **Vancouver Art Gallery**. Architect Arthur Erickson designed these two features of the downtown core. Located at the intersection of Robson street and Hornby street, Robson Square is an amalgam of office and open spaces. The New Courthouse, on the main level borders a public space replete with a waterfall and trees. A partially-covered, lower level is open to the public. Conference rooms, two theatres, exhibition space, and cafes and restaurants surround an ice-skating rink, which converts, to an outdoor dance floor and entertainment center in the summer.

Across the street, in the old Provincial Courthouse, Erickson designed the **Vancouver Art Gallery**. Taking up one square block in the

center of downtown Vancouver, it is the largest Canadian art museum west of Toronto and the fourth largest in Canada. It houses touring exhibitions of painting, sculpture, graphic arts, photography and video that address both historical and contemporary issues. In addition, at any one time, the Vancouver Art Gallery houses a featured exhibition. The gallery also houses a permanent collection of Dutch paintings from the 17th and 18th centuries, modern British paintings and sculpture, and sculpture, paintings and drawings by one of Canada's best known artists, **Emily Carr**. The permanent gallery showing Carr's work is on the third floor. This is the largest collection of her work anywhere. A word of advice: don't ask a Canadian who Carr is; that's like asking an American who Georgia O'Keefe is! FYI: Until 6 November Impressionist Masterworks featuring 13 exquisite paintings by Monet, Pissarro, Sisley, Renoir, Van Gogh and others is on display. Continuing shows include the following. *Colouring the West: A Century of B.C. Painting*. This examines the influences and trends in 20th century painting in B.C. through works by B.C. Binning, Gathie Falk, Jack Shadbolt, Derek Root and many others. *Between Two Worlds: The Art of Poland 1890-1914*. Examples of early Modernist art rarely shown outside Poland. Emily Carr Paintings and prints of West Coast landscapes and aboriginal cultures as depicted by the renowned B.C. artist. Open Mon.—Sun. and holidays 10 a.m.—5:30 p.m. (Thur. 5:00 p.m.—9:00 p.m.; suggested donation \$5). Admission \$10, (discount for seniors on Tuesdays; \$5), students \$6, children aged 12 and under free; family/group rate \$30.

Opened in May 1995, the Vancouver Public Library is one of the most striking bits of modern architectural design in Vancouver. Located at 350 West Georgia (east of Robson Square on Robson), its distinctive style has made it a Vancouver landmark; moreover, it is a great place to explore. Resist hitting the stacks, and enjoy exploring the plazas, investigating the shops in the entrance gallery and observing the unusual architecture. In addition, within the public area, there are 131 photo albums, containing a large sampling of photographs from Vancouver's history, and the history of the province.

Not interested in architecture? In Vancouver and the surrounding region you'll find great shopping—good enough to keep even the most seasoned shopper pleased. From the upscale shops of **Robson Street**, to the waterside wares of **Granville Island**, you're sure to find a wide variety of shopping and culinary experiences in Vancouver.

The area west of Burrard Street developed a strong diverse ethnic flavor during the 50's and 60's, and has developed into a very vibrant pedestrian traffic area. Familiarly known as the **West End**, it has one of Canada's highest population densities. The small shopfront character is an attractive feature of the area. Along **Robson Street** take advantage of a fashionable collection of designer stores, boutiques, and international cuisine in many first class restaurants. This is a trendy, immensely popular street. Recharge with a cappuccino at a sidewalk café and people-watch to your

hearts content. Further west, check out the many restaurants and coffee bars on Denman Street.

Track down some original West Coast aboriginal art and the latest in fashion at stores lining the cobblestone streets, or enjoy one of the many restaurants and clubs in **Gastown**. The Gastown area of Vancouver was named for a talkative Yorkshire-born saloon owner, John Deighton, nicknamed Gassy Jack. As the story goes, Gassy Jack showed up with a barrel of whiskey on the south shore of Burrard Inlet. He offered the resident mill workers all the whiskey they could drink if they helped him build a saloon—24 hours later he was the proud owner of a saloon. A permanent feature of Gastown is the Gastown Steam Clock. Built by Raymond Saunders in 1977, it is based on an 1875 design. It is the only one of its kind in the world and is powered by steam from an underground system of pipes that supply steam to heat many downtown buildings. NOTE: Raymond Saunders owns The Gastown Steam Clock Company just opposite the clock.

Check out the shops, restaurants and outdoor markets in North America's second largest Chinese commercial centre. For the individual that makes it to **Chinatown**, check out the **Dr. Sun Yat-Sen Classical Chinese Garden**. Apparently, it is the only full-sized classical Chinese garden outside China. Chinese craftsmen built it employing authentic materials and techniques, in the 1980s. The peacefulness of the garden is its attraction. It is a small walled garden, featuring carefully landscaped planting, architecture, water and trees. For a slight digression to buildings, look for the world's thinnest office building on the corner of Pender and Carrall streets in Chinatown. Built in 1913 and currently occupied by a regular operating business, the **Sam Kee Building** is only 1.8 meters (six feet) wide.

In the heart of Vancouver lies the **Granville Island Public Market**. Part farmers market, part artist studio and part magnet for the creative and flamboyant—it's one of the busiest spots in Vancouver. It offers everything from fresh cut bouquets of flowers, fruit, and vegetables to seafood. Street performers abound in this former industrial area on False Creek. It has become an eclectic mix of boatyards and bookstores, studios and toy stores, restaurants and galleries, cafés and craft stores—and one of Vancouver's liveliest places. After shopping at the Market, enjoy lunch or dinner at one of the many fine restaurants on Granville Island. Granville Island is the place to spend a leisurely afternoon.

**Plan to visit with one another
during the scheduled coffee breaks!**

Regency East near the Book Exhibit

**Friday, Saturday, and Sunday: 10:15 a.m.—10:30 a.m.
Friday, and Saturday: 3:10 p.m.—3:30 p.m.**

HSS / PSA 2000 ANNUAL MEETING

Committees and Interest Groups Schedule of Meetings

Thursday, 2 November

TIME	ROOM
1:00 p.m.—5:00 p.m. HSS Council Meeting	Peacock's Room
2:00 p.m.—5:00 p.m. PSA Governing Board Meeting	Windsor

Friday, 3 November

TIME	ROOM
7:30 a.m.—9:00 a.m. HSS Women's Caucus Meeting	Peacock's Room
7:30 a.m.—9:00 a.m. <i>Isis</i> Editorial Board Meeting	Peacock's Lounge
12:00 p.m.—1:30 p.m. HSS Committee on Finance Meeting	Cavendish
12:00 p.m.—12:30 p.m. "Forum for the History of Science in America, Business Meeting"	Regency Centre
12:00 p.m.—1:00 p.m. PSA Business Meeting	Regency West
12:00 p.m.—1:30 p.m. HSS Committee on Honors and Prizes	Constable
12:00 p.m.—1:30 p.m. HSS Committee on Education	Kensington
6:00 p.m.—7:00 p.m. Dibner Committee Meeting	Constable

Friday, 3 November

- 7:00 p.m.—8:30 p.m.** **Grouse**
“Special Interest Group in the History of Astronomy, Meeting”
- 7:30 p.m.—9:00 p.m.** **Peacock’s Room**
“Forum for the History of Human Sciences, Meeting”
- 7:30 p.m.—9:00 p.m.** **Hy’s Encore, 637 Hornby Street**
History of Chemistry Interest Group

Saturday, 4 November

- | TIME | ROOM |
|--|-------------------------|
| 7:00 a.m.—9:30 a.m.
<i>Osiris</i> Editorial Board Meeting | Kensington |
| 8:00 a.m.—9:00 a.m.
Forum for the History of Science in America Steering Committee Meeting | Constable |
| 11:45 a.m.—1:30 p.m.
HSS Nominating Committee Meeting | Constable |
| 12:00 p.m.—1:00 p.m.
Backstage at the Journal (<i>Philosophy of Science</i>) | Peacock’s Room |
| 12:00 p.m.—1:30 p.m.
<i>HOPOS</i> Steering Committee Meeting | Peacock’s Lounge |
| 12:00 p.m.—1:30 p.m.
“Earth and Environment Forum, Business Meeting” | Balmoral |
| 12:00 p.m.—3:00 p.m.
HSS Committee on Publications Meeting | Kensington |
| 12:00 p.m.—1:30 p.m.
HSS Committee on Meetings and Programs Meeting | Cavendish |
| 12:00 p.m.—1:30 p.m.
HSS Committee on Research and the Profession Meeting | Tennyson |
| 6:00 p.m.—7:00 p.m.
HSS Distinguished Lecture | Regency Centre |

HSS FULL PROGRAM SCHEDULE

Thursday, 2 November
5:00 p.m.—7:00 p.m.
Regency West

Plenary Session
Particularity and its Problems

7:00 p.m.—9:00 p.m. Reception Hyatt Hotel, Regency Centre

7:30 p.m.—9:30 p.m. Reception Museum of Anthropology
(Ticketed Admission)

Buses will be located at the Melville Street Entrance

Friday, 3 November
9:00 a.m.—11:45 a.m.

Crafting Knowledge, Defining Nation: Science and Identity in Canadian History	Plaza East
Coping with Information Overload in Early Modern Natural Philosophy	Regency West
Voyages of science/The science of voyages	Stanley
Science in Twentieth-Century China: The Importance of Place	King George
Science and Cinema	Regency Centre
Contested Darwinisms: Lives, Organisms, and Synthesis Stories	Plaza West
Biological Invaders, Scientific Defenders: Entomologists and Exotics, 1776-1968	Balmoral
The Values of Interdisciplinarity	Oxford Room
Cultures of 20th-Century Astronomy	Prince of Wales

Friday, 3 November
12:30 p.m.—1:30 p.m.
Regency Centre

Forum for the History of Science in America
Distinguished Scientist Lecture

Estella Leopold, *University of Washington*
“Ecologists and the Land Ethic”

Friday, 3 November
1:30 p.m.—3:10 p.m.

State-Sponsored Science during the Cold War	King George
Expanding Conceptions of the Scientific Revolution	Prince of Wales
Science, Culture and Weltanschauung in Interwar Europe	Plaza East
18th and 19th-Century German physiology and philosophy	Brighton
Psychology and Society in Mid-20th Century America	Plaza Centre
Growing and Knowing:	
Science, Standardization, and American Youth	Plaza West
Readers, Writers, and Audiences, 1500-1900	Regency Centre
Redefining Physics: Science, Culture, and Politics	
in the 20th Century East Asia	Balmoral
Exploring the Earth:	
Conceptual and Economic Infrastructures,	
1650-1900	Lord Byron

Friday, 3 November
3:30 p.m. — 5:30 p.m.

Nature's Empires:	
Museums and the Cultivation	
of Knowledge in the Pacific	
Part I—Exploring Meanings	Regency Centre
Prospects for a History of Social Science	Plaza Centre
A Civilizing Science:	
The Political Culture of Public Health	
in 19th-Century France	King George
Authority, Originality, Piracy:	
Histories of Intellectual Property	Regency West
Science and National Politics	
in Twentieth-Century Yugoslavia	Oxford Room
Polemics, Philosophy, and Experiment in Chymistry	Plaza West
Progressive Science and Technology:	
The Role of Scientists and Engineers	
in the American Progressive Movement	Balmoral
Music and Science in Cultural Context	Prince of Wales
Victorian Crisis of Objectivity:	
The Revolt Against Scientific Completeness	Plaza East

Friday, 3 November

5:30 p.m.—7:30 p.m. Reception Hyatt Hotel, Regency Foyer



Friday, 3 November
7:30 p.m.— 9:00 p.m.

Nature's Empires:
 Museums and the Cultivation of Knowledge in the Pacific
 Part II—Creating Memories
(Prince of Wales)

Making Encyclopedias in the History of Science:
 Mechanics, Benefits, Tribulations
 (A Roundtable Discussion)
(King George)

Teaching Controversial Topics in the History of Science:
 Committee on Education Workshop
(Oxford)

Saturday, 4 November
9:00 a.m.—11:45 a.m.

Revolutionary Science	Brighton
Natural Knowledge, Expertise and the Early Modern State	Prince of Wales
From the Ground Up:	
Insects and Models of Science,	
Reason and Community	King George
Maps for Enlightenment:	
Cartography and Science	
in the Eighteenth Century	Plaza West
Representations and Reality:	
Iconography and Gendered Careers in Science	Balmoral
Spaces of Health and Illness	Regency Centre
Constructing Cells and Growing Organisms:	
Topics in the History of Cytology	
and Developmental Biology I	Regency West
Astronomy and Its Histories:	
A Session in Honor of Owen Gingerich	Plaza East
North-South Scientific Relations During the Cold War	Plaza Centre

Saturday, 4 November**1:30 p.m.—3:10 p.m.**

Laboratory Science and Contingent Knowledge in American Veterinary Medicine	Brighton
Forging Alchemical Identities: Strategies for Legitimizing Authority in Early Modern Alchemy	King George Plaza East
Science and Race in the 20th Century	Plaza Centre
Ancient and Medieval Natural Knowledge and Practices	Balmoral
Philosophy and Mind in the 18th and 19th Centuries	
Displaying Biomedical Authority in Modern Anglo-American Culture	Prince of Wales
Constructing Cells and Growing Organisms: Topics in the History of Cytology and Developmental Biology II	Plaza West
Physics in 20th-Century Europe: From the Classical World to the Quantum Universe	Regency Centre
Theory Comes West: The Beginnings of Theoretical Astrophysics in Western America	Regency West

Saturday, 4 November**3:30 p.m.—5:30 p.m.**

Science in National and Transnational Contexts	Regency Centre
The Science and Spectacle of Man: Popularization and Professional Debates in American Anthropology	Prince of Wales
Biology, Sexuality, and Morality in Modern France	Regency West
Modern Science and the Clergy	Plaza West
North Sea Passage: Cross-Channel Scientific Currents, 1780-1850	King George Plaza East
Amateurs of Science in Early Modern Europe	
Uncle Sam in the Laboratory: Biomedical Science and the Federal Government	Brighton
Mechanics and Imagery	Lord Byron
Exhibiting the Evanescent in Victorian Science and Technology	Plaza Centre



Saturday, 4 November
6:00 p.m.—7:00 p.m.
Regency Centre

HSS Distinguished Lecture

Mary Jo Nye, *Oregon State University*
“The Cultural and Political Sources of Science as Social Practice”

INTRODUCTION: Diana Barkan, California Institute of Technology

HSS Banquet
8:00 p.m.—10:30 p.m.
(Regency West)

10:30 p.m.—12:00 a.m.
Graduate Student Party
(Regency Foyer)

Sunday, 5 November
9:00 a.m.—11:45 a.m.

Computer Simulations as Evidence, Experiment, and Argument	
Historical and Philosophical Perspectives	Seymour
Psychology, Popularization, and the Public	Balmoral
Resurrecting Physical Theory:	
Approaches to Theory Construction, 1700-1970	Stanley
Proprietary Knowledge in Biomedical Science and Industry,	
1890-Present	Plaza East
Method in the 19th-Century Physical Sciences	Grouse
Putting Nature on Show in Early Modern Europe	Plaza West
Galileo’s Optics	Plaza Centre
Darwinian Heresies	Cypress

HSS 2000 PROGRAM

Thursday, 2 November

Plenary Session

5:00 p.m.—7:00 p.m.

Particularity and its Problems

Heinrich von Staden, *Institute for Advanced Study*, 'For the most part...' particularity and the language of exception in ancient science

Kathryn Olesko, *Georgetown University*, Aesthetic Precision: Particularity and Social Fact

Robert Kohler, *University of Pennsylvania*, Particularity in Field Biology

CHAIR AND COMMENTATOR: Andrew Warwick, Imperial College

ORGANIZERS: Thomas H. Broman, University of Wisconsin, Madison; Lynn K. Nyhart, University of Wisconsin, Madison; and John Harley Warner, Yale University

Reception

7:00 p.m.—9:00 p.m.

(Hyatt Hotel, Regency Centre)

Reception

7:30 p.m.—9:30 p.m.

(Museum of Anthropology—Ticketed Admission)

Hosted by the President's Office of the University of British Columbia, this reception complements the special sessions, "Nature's Empires: Museums and the Cultivation of Knowledge in the Pacific."

(Buses will be at the Melville Street Entrance)

Friday, 3 November

9:00 a.m.—11:45 a.m.

**indicate session organizer(s)*

Crafting Knowledge, Defining Nation: Science and Identity in Canadian History (Plaza East)

***Edward Jones-Imhotep**, *Harvard University*, Ionograms, Identity, and the 'Idea of North'

Stephen Bocking, *Trent University*, Science, Politics, and Perceptions of the Arctic Environment

Suzanne Zeller, *Wilfrid Laurier University*, Elective Affinities: National Identity and Early Timber Researches at McGill University, 1894-1910

CHAIR: Ronald L. Numbers, University of Wisconsin, Madison



Friday, 3 November

9:00 a.m.—11:45 a.m.

**indicate session organizer(s)*

**Coping with Information Overload in Early Modern Natural
Philosophy
(Regency West)**

Richard Yeo, *Griffith University*, A Solution to the Multitude of Books: Ephraim Chambers' *Cyclopaedia* (1728) as "the Best Book in the Universe"

***Ann M. Blair**, *Harvard University*, Reading Strategies for Coping with Information Overload

Brian W. Ogilvie, *University of Massachusetts, Amherst*, The Many Books of Nature: How Renaissance Botanists Created and Responded to Information Overload

Jonathan Sheehan, *Indiana University*, From Philology to the Fossil: The Biblical Encyclopedia in Early Modern Europe

CHAIR AND COMMENTATOR: Daniel Rosenberg, University of Oregon

**Voyages of science/The science of voyages
(Stanley)**

***Jordan Goodman**, *University of Manchester Institute of Science and Technology*, Mr. Huxley's Voyage? Making Imperial Space and Knowledge in the mid-19th Century

Londa Schiebinger, *Max Planck Institute for the History of Science*, Gender in the Voyages of Scientific Discovery

Richard J. Sorrenson, *Indiana University*, From South Col to South Pole: Sir Edmund Hillary and the British Commonwealth Expeditions to Everest and Antarctica in the 1950s

Janet Browne, *Wellcome Institute for the History of Medicine*, Scientific Research Expeditions: Scott and the Discovery, 1901-1904

CHAIR AND COMMENTATOR: Rebecca Ullrich, Sandia National Laboratories

**Science in Twentieth-Century China: The Importance of Place
(King George)**

E. Elena Songster, *University of California, San Diego*, Forests Stand for Pandas: Scientific Forestry and Nature Reserves in Sichuan, China

Grace Y. Shen, *Harvard University*, Mining the Cave: Global Visions and Local Traditions in the Story of Peking Man

***Sigrid Schmalzer**, *University of California, San Diego*, Breeding a Modern China: The Making of the Dingxian Pig, 1929-1937

Brian Greene, *University of California, Los Angeles*, Making the Invisible Visible: The Public Health Efforts of W. W. Peter and Tee Han Kee in Early 20th Century China and The Philippines

COMMENTATOR: Liang Kan, Seattle University

CHAIR: Marta Hanson, University of California, San Diego

**Science and Cinema
(Regency Centre)**

Susan E. Lederer, *Yale University*, Celluloid Science: Teaching Science Using Popular Film in the 1930s and 40s

***Hannah L. Landecker**, *Max Planck Institute for the History of Science*, Microcinema: Time Lapse Cinematography in Biology 1909-1930

T. Hugh Crawford, *Georgia Institute of Technology*, Filming the Event: Technology, Temporality, and the Object of Science

***Karen A. Rader**, *Sarah Lawrence College*, Teaching “Science and Film:” Visual Representation as a Pedagogical Window on Artistic and Scientific Practice

CHAIR: Hannah L. Landecker, Max Planck Institute for the History of Science

**Contested Darwinisms:
Lives, Organisms, and Synthesis Stories
(Plaza West)**

Robert J. Richards, *The University of Chicago*, Why Haeckel Became a Virulent Darwinian

Sander J. Gliboff, *Johns Hopkins University*, The Case of Paul Kammerer

***Patricia M. Princehouse**, *Harvard University*, Mutant Phoenix: Macroevolution from Germany to the U.S.

Chris Pires, *University of Wisconsin, Madison*, Power of the Unified Narrative: Placing Botany in the Evolutionary Synthesis

CHAIR AND COMMENTATOR: Garland Allen, Washington University

**Biological Invaders, Scientific Defenders:
Entomologists and Exotics, 1776-1968
(Balmoral)**

***Philip J. Pauly**, *Rutgers University, New Brunswick*, Fighting the Hessian Fly: Ecology and Diplomacy in a Time of Revolution

George D. Gale, *University of Missouri, Kansas City*, Comprehending the Catastrophe: The Role of Medical Models in the Phylloxera Grapevine Disaster, France 1870-1900

Sarah Jansen, *University of Cambridge / Max Planck Institute for the History of Science*, Arsenic and Candy: The Colorado Beetle in Germany, 1875-1914

Joshua Blu Buhs, *University of Pennsylvania*, The Naturalization of the Imported Fire Ants

COMMENTATOR: Mark L. Winston, Simon Fraser University

CHAIR: Michael A. Osborne, University of California, Santa Barbara

Friday, 3 November

9:00 a.m.—11:45 a.m.

**indicate session organizer(s)*

**The Values of Interdisciplinarity
(Oxford Room)**

Jeremiah L. James, *Harvard University*, Disparate Bonds: Ends and Means in Early Quantum Chemistry

Silvan S. Schweber, *Brandeis University*, Interdisciplinarity, Theory, the Computer and the Physical Sciences

***Jamie N. Cohen-Cole**, *Princeton University*, The Cognitive Revolution and the Culture of Interdisciplinarity

Timothy Lenoir, *Stanford University*, Accelerating Discovery: Bioinformatics and Interdisciplinarity

CHAIR AND COMMENTATOR: Cathryn L. Carson, University of California, Berkeley

**Cultures of 20th-Century Astronomy
(Prince of Wales)**

Matthew Stanley, *Harvard University*, Science and the Spiritual Quest: Religion, Epistemology, and Eddington's Stellar Models

Keith R. Lafortune, *University of Notre Dame*, Pickering's Harem and the New Sociology of Astronomy, 1877-1919

Abha Sur, *Massachusetts Institute of Technology*, Identity and Ideology in Meghnad Saha's Physics

David P. D. Munns, *Johns Hopkins University*, Becoming Astronomy: Why Cosmic Noise became Radio Astronomy

JoAnn Palmeri, *Independent Scholar*, Sagan and Shapley: The Astronomer as Prophet of Science in the Twentieth Century

CHAIR: Pamela E. Mack, Clemson University

**Friday 3 November
12:30 p.m.—1:30 p.m.
Regency Centre**

**Forum for the History of Science in America
Distinguished Lecture**

Estella Leopold, *University of Washington*
"Ecologists and the Land Ethic"

Friday, 3 November

1:30 p.m.—3:10 p.m.

**indicate session organizer(s)*

State-Sponsored Science during the Cold War

(King George)

Audra J. Wolfe, *University of Pennsylvania*, Protecting Turfs (Literally): Negotiating the Meanings of Exobiology at the Dawn of the Space Age

Ulf von Rauchhaupt, *Max Planck Institute for the History of Science*, Colorful Clouds: West Germany's First Steps into Experimental Space Science in the Early 1960s

Gerard J. Fitzgerald, *Carnegie Mellon University*, "Mechanization through Standardization," Bacteriological Engineers and Biological Weapons at LOBUND, 1928-1955

Rebecca P. Schwartz, *Princeton University*, Writing the Authorized Biography of the Manhattan Project: Harry DeWolf Smyth and the Smyth Report

CHAIR: Nadine Weidman, Harvard University

Expanding Conceptions of the Scientific Revolution

(Prince of Wales)

Maurice A. Finocchiaro, *University of Nevada, Las Vegas*, Giordano Bruno, 1600-2000

David N. Harley, *University of Notre Dame*, "The Scientific Revolution": Boxing for England?

Eric J. Palmer, *Allegheny College*, A Philosophical Education Program: Descartes *selon l'ordre des recitations*

Jongtae Lim, *Harvard, Yenching Institute*, Taming the Spherical Earth and "Globalizing" the Traditional Cosmology in the Late Choson Dynasty Korea

CHAIR: Sheila Rabin, St. Peter's College

Science, Culture and Weltanschauung in Interwar Europe

(Plaza East)

Cristina Chimisso, *Open University, UK*, H el ene Metzger: The History of Science between the History of Mentalities and Total History

Sofie Lachapelle, *University of Notre Dame*, Materializing Authority: The 1922 Psychological Experiments at the Sorbonne

Susan M. Lanzoni, *Harvard University*, On the Common Ground of Experience: Ludwig Binswanger's Phenomenological Psychopathology

Deborah R. Coen, *Harvard University*, Taking Nature's Pulse: The Place of the Organic in Austrian Physics

CHAIR: Everett Mendelsohn, Harvard University

Friday, 3 November

1:30 p.m.—3:10 p.m.

**indicate session organizer(s)*

**18th and 19th-Century German physiology and philosophy
(Brighton)**

Monica Libell, *Lund University, Sweden*, Physiology, Civilization and the Pain of Vivisection

Nancy A. Anderson, *University of Michigan*, One Complex Amoeba: Image, Imagination, Cell Theory and the Bioplaxion Doctrine

CHAIR: Sylvia McGrath, Stephen F. Austin University

Psychology and Society in Mid-20th Century America

Session cosponsored by the Forum for the History of Human Science

(Plaza Centre)

John Carson, *University of Michigan*, Peace Work: Intelligence, Merit, and the Limits of Democracy

Sarah E. Igo, *Princeton University*, Arguing with Gallup: Popular Challenges to ‘Scientific’ Polling, 1936-1948

Wade E. Pickren, *American Psychological Association*, Life and the “Age of Psychology”: The Public Image of Psychology in the 1950s

Nathan L. Ensmenger, *University of Pennsylvania*, Chess Players, Music Lovers, and Mathematicians: Towards a Psychological Profile of the Ideal Computer Scientist

CHAIR: Elizabeth Lunbeck, Princeton University

Growing and Knowing:

Science, Standardization, and American Youth

(Plaza West)

***Heather Munro Prescott**, *Central Connecticut State University*, “I Was a Teen-Age Dwarf,” or What is “Normal” Adolescent Development?

Susan A. Miller, *University of Pennsylvania*, Health in the Balance: Learning Lessons from the Landscape at Girls’ Summer Camps, 1910-1930

Elizabeth A. Toon, *Cornell University*, Measuring Up: Schoolchildren and Representations of Physical Growth in the Interwar United States

CHAIR AND COMMENTATOR: Sarah W. Tracy, University of Oklahoma

Readers, Writers, and Audiences, 1500—1900

(Regency Centre)

Richard D. Cunningham, *Pennsylvania State University*, Moveable Visual Images and Active Reading Practices in the Education of Sixteenth-Century English Navigators

Nicole C. Howard, *Indiana University*, The King, the Courtier and the Clockmaker: Christiaan Huygens and Interpretations of Audience

Ellen J. Valle, *University of Turku, Finland*, From Sloane to Owen: Epistolary Episodes in the Construction of Natural History

Aileen Fyfe, *University of Cambridge*, Industrialised Conversion: Publishing popular science and religion in Victorian Britain

CHAIR: H. F. Cohen, University of Twente

Redefining Physics:

Science, Culture, and Politics in the 20th Century East Asia

(Balmoral)

***Kenji Ito**, *Harvard University*, “Culture of Calculating”: Theory and Practice of Theoretical Physics in the 1920s Japan

Dong-Won Kim, *Korea Advanced Institute of Science & Technology*, Why Physics? The Conflicting Role and Image of Physics in South Korea

Danian Hu, *Yale University*, The “Great Proletarian Scientific Revolution”: Einstein and his Relativity during China’s Cultural Revolution

COMMENTATOR: James R. Bartholomew, Ohio State University

CHAIR: Martin J. Klein, Yale University

Exploring the Earth: Conceptual and Economic Infrastructures,

1650—1900

(Lord Byron)

Andre Wakefield, *Dibner Institute for the History of Science and Technology*, Science and Silver in the Mines of Central Europe, 1650-1850

Alexey V. Kuprijanov, *The S. I. Vavilov Institute for the History of Science and Technology*, Natural History in Russia before the 1860s: Conceptual and Institutional Developments

Brian C. Shipley, *Dalhousie University*, “My fact, therefore, I now consider established beyond controversy”: William E. Logan, the Origin of Coal Debate, and the Writing of the History of Geology

Steven W. Ruskin, *University of Notre Dame*, Private Science, Public Imagination, and the Ambitions of Empire: Perceptions of John Herschel’s Cape Voyage, 1833-1838

CHAIR: Ernst Hamm, York University



Friday, 3 November

3:30 p.m. — 5:30 p.m.

**indicate session organizer(s)*

Nature's Empires:

Museums and the Cultivation of Knowledge in the Pacific

Part I—Exploring Meanings

Session cosponsored by the Pacific Circle

(Regency Centre)

Introduction: Roy MacLeod and Philip F. Rehbock, Viewing the Pacific through European Eyes: Constructing Meanings and Memories

Sujit P. Sivasundaram, *Christ's College, University of Cambridge*, Objects of this World: Missionaries, Museums and the South Pacific

Richard W. Burkhardt, Jr., *University of Illinois, Urbana-Champaign*, The School for Naturalist-Voyagers

Jim Endersby, *University of Cambridge*, "From Having No Herbarium": Local Knowledge vs. Metropolitan Expertise: Joseph Hooker's Australasian Correspondence with William Colenso and Ronald Gunn

Janet Garber, *Independent Scholar*, Jane Franklin and the Natural History Museum Idea in Tasmania

CHAIR: Roy MacLeod, University of Sydney

Prospects for a History of Social Science

Session cosponsored by the Forum for the History of Human Science

(Plaza Centre)

Dorothy Ross, *Johns Hopkins University*, The Social Science Disciplines in Europe and the U.S.: Enlarging the Historical Lens

***Theodore M. Porter**, *University of California, Los Angeles*, Project for a History of Social Science, 1750-1890

Mitchell G. Ash, *University of Vienna*, A Human Science? Psychology as Science and Profession, 1850-1970

Mary O. Furner, *University of California, Santa Barbara*, The Enlightenment Ideal, the Social Sciences, and Governance, 1880's-1940's

CHAIR: Theodore M. Porter, University of California, Los Angeles

A Civilizing Science:

The Political Culture of Public Health in 19th-Century France

Session cosponsored by the American Association for the History of Medicine

(King George)

***Ann F. La Berge**, *Virginia Polytechnic Institute and State University*, Dirty Stories: Investigative Reporting as Scientific Practice on the 19th-Century French Health Councils

David S. Barnes, *Harvard University*, Street-Level Etiologies: The Political and Cultural Stakes of "Local Knowledge" in French Public Health, 1880-1900

Cherilyn M. Lacy, *Hartwick College*, Science Marches across the Threshold:

From Public Health to Domestic Hygiene in Nineteenth-Century France

CHAIR AND COMMENTATOR: Martha Hildreth, University of Nevada, Reno

**Authority, Originality, Piracy: Histories of Intellectual Property
(Regency West)**

Mario Biagioli, *Harvard University*, Inventions, Instruments, and Discoveries: Priority and 'Intellectual Property' in Galileo's Venice

***Ken Alder**, *Northwestern University*, "PASCAL DEFEATS NEWTON!" Or, Originality and Verisimilitude in History and Science

Adrian D. Johns, *University of California, San Diego*, What We Can Learn from the History of Piracy

CHAIR AND COMMENTATOR: Lorraine Daston, Max Planck Institute for the History of Science

**Science and National Politics in Twentieth-Century Yugoslavia
(Oxford Room)**

Ljubinka Trgovcevic, *Historical Institute, Belgrade*, Science of Borders: The Uses of Jovan Cvijic's Geography at the Paris Peace Conference 1919-20

***Vladimir Jankovic**, *University of Manchester*, Fear and Medical Politics of the 1999 Solar Eclipse in Serbia

Marija Sestic, *Museum of Science and Technology, Belgrade*, The Electrical Icon: National Appropriations of Nikola Tesla, 1945-1999

COMMENTATOR: Gale Stokes, Rice University

CHAIR: Ron Doel, Oregon State University

**Polemics, Philosophy, and Experiment in Chymistry
(Plaza West)**

William Newman, *Indiana University*, The Fire-Analysis Debate Before Boyle and Van Helmont

Bruce T. Moran, *University of Nevada, Reno*, Libavius, Polemics & Alchemy: The Transmutation of Emotion and Rationality

***Alice Stroup**, *Bard College*, Duclos on Boyle: A French Academician Criticizes "Certain Physiological Essays"

CHAIR AND COMMENTATOR: Lawrence M. Principe, Johns Hopkins University

**Progressive Science and Technology: The Role of Scientists and
Engineers in the American Progressive Movement**

(Balmoral)

***Christian C. Young**, *Mount Angel Seminary*, American Wildlife Organizations in the Progressive Era

***Mark A. Largent**, *Oregon State University*, Biological Justifications for Progressive Reform

Jennifer K. Alexander, *University of Minnesota*, Engineers, Charlatans, and Progressive Efficiency

CHAIR AND COMMENTATOR: Barbara A. Kimmelman, Philadelphia University

Friday, 3 November

3:30 p.m.—5:30 p.m.

**indicate session organizer(s)*

**Music and Science in Cultural Context
(Prince of Wales)**

Anna Sofie Christiansen, *University of Copenhagen*, Hermann Scherchen's Gravesano Project: Cultural Globalization through Scientific Verification of Western Art Music

***Charles M. Brotman**, *University of Rochester*, Helmholtzian Acoustics in a Darwinian Key: James Sully, Edmund Gurney, and the Psychology of Music in Victorian Culture

Brandon Konoval, *University of British Columbia*, Music and the Book of Nature: Pythagorean Tradition and Empirical Mathematics in the Discourses of Vincenzo Galilei

CHAIR AND COMMENTATOR: Amy S. Bix, Iowa State University

**Victorian Crisis of Objectivity: The Revolt Against Scientific
Completeness
(Plaza East)**

Joan L. Richards, *Brown University*, Sophia and Augustus DeMorgan's Faith of Mind

***Paul J. Croce**, *Stetson University*, William James on the Healing Arts

Frederick Gregory, *University of Florida*, Continental Critiques of Scientific Objectivity

CHAIR AND COMMENTATOR: Jon Roberts, University of Wisconsin, Stevens Point

Friday, 3 November

7:30 p.m.— 9:00 p.m.

**indicate session organizer(s)*

**Nature's Empires:
Museums and the Cultivation of Knowledge in the Pacific
Part II—Creating Memories**

Session cosponsored by the Pacific Circle

(Prince of Wales)

John Barker, *University of British Columbia*, Dangerous Artifacts: A Case Study in Local and Global Negotiations of the Meaning of Indigenous Objects
Alexia Bloch, *University of British Columbia*, Crisis or Crossroads?: Museums in the Russian Far East Reinterpreting State Narratives

Kerri A. Inglis, *University of Hawaii*, The Representation and Commodification of Suffering: Kalaupapa National Historical Park

CHAIR: Roy MacLeod, University of Sydney

Making Encyclopedias in the History of Science:

Mechanics, Benefits, Tribulations

(A Roundtable Discussion)

(King George)

Gary B. Ferngren, *Oregon State University*

Gregory A. Good, *West Virginia University*

Sylvia K. Miller, *Routledge/Taylor & Francis Publishers*

Valerie Tomaselli, *The Moschovitis Group*

Arne Hessenbruch, *Dibner Institute*

CHAIR: *Helaine Selin, *Hampshire College*

Teaching Controversial Topics in the History of Science

Committee on Education Workshop

(Oxford Room)

Edward B. Davis, *Messiah College*, Teaching Science and Religion

David C. Lindberg, *University of Wisconsin*, Teaching the History of Science and Religion in a Public University: Pitfalls and Opportunities

Susan Lindee, *University of Pennsylvania*, Science Students and the Science Wars

Londa Schiebinger, *Pennsylvania State University*, Approaches to teaching Gender in Science

Bruce J. Hunt, *University of Texas, Austin*, Teaching the History of the Atomic Bomb

CHAIR: *Pamela H. Smith, *Pomona College*

Saturday, 4 November

9:00 a.m.—11:45 a.m.

**indicate session organizer(s)*

Revolutionary Science

(Brighton)

***Theresa Levitt**, *Harvard University*, Regenerated Art and Engineering Drawing: The Jacobin Foundations of the Ecole Polytechnique

Denise Phillips, *Harvard University*, Citizenship and Science: German Civic Science Societies and the Revolutions of 1848

Alexei Kojevnikov, *Center for History of Physics, American Institute of Physics*, The Great War, the Russian Civil War, and the Invention of Big Science

Cong Cao, *University of Oregon*, Ideology and Chinese Science

COMMENTATOR: Dorinda Outram, *University of Rochester*

CHAIR: Roger Hahn, *University of California, Berkeley*

Saturday, 4 November
9:00 a.m.—11:45 a.m.
**indicates session organizer(s)*

Natural Knowledge, Expertise and the Early Modern State
(Prince of Wales)

Eric H. Ash, *Princeton University*, Queen v. Northumberland: Royal Mining Rights and the Dilemma of Expertise

Emily K. Brock, *Princeton University*, Gardeners and Botanists in the Study of Forests in England, 1650-1800

Florence C. Hsia, *Wayne State University*, Missionaries, Monks, and Mathématiciens du roi in the Ancien Régime

***Matthew L. Jones**, *Columbia University*, Calculating Machinery: Pascal and Leibniz on Knowledge and Spectacle in the Early Modern State

Jordan Kellman, *Louisiana State University*, Jean Mattieu de Chazelles and the Birth of Naval Science in 17th-century France

CHAIR: Pamela H. Smith, Pomona College

From the Ground Up:
Insects and Models of Science, Reason and Community
(King George)

Jonathan Clark, *University of Canterbury, Kent*, History from the Ground Up: Bugs Political Economy and God in Early Nineteenth Century Britain

***Katharine Anderson**, *York University*, Instincts and Instruments

Alison Winter, *California Institute of Technology*, Snails, Leeches, Mediums, and Conductors: The Use of Living Things as Instruments in Mid-Nineteenth Century Europe

Charlotte L. Sleight, *University of Canterbury, Kent*, Brave New Worlds: Sociological Explanations of the Ants in the 1920s & 1930s

CHAIR AND COMMENTATOR: Harriet Ritvo, Massachusetts Institute of Technology

Maps for Enlightenment:
Cartography and Science in the Eighteenth Century
(Plaza West)

Matthew H. Edney, *University of Southern Maine*, Mapping Eighteenth-Century Intersections of Scientific and Cartographic Practices

Anne Godlewska, *Queen's University, Kingston*, When is Description Mere Description? The Nature of 18th-Century Geography

Michael T. Bravo, *University of Cambridge*, Enlightened Precision in Geography and Anthropology

Michael S. Dettelbach, *Smith College*, Map as Metaphor, Map as Math: The Meanings of Cartography in the Enlightenment

COMMENTATOR: John Heilbron, Oxford

CHAIR: *D. Graham Burnett, University of Oklahoma

**Representations and Reality:
Iconography and Gendered Careers in Science**

Session sponsored by the HSS Women's Caucus

(Balmoral)

Maura C. Flannery, *St. John's University*, *The Lab Coat: Symbol of Science as a Male Pursuit*

Robert Hendrick, *St. John's University*, *Gender Stereotyping in Visual Images of French Science Popularization, 1870-1914*

Abena Osseo-Asare, *Harvard University*, *Gender and Workplace in the Gold Coast*

Marianne Gosztonyi Ainley, *University of Northern British Columbia*, *Gendered Careers? Canadian Women in Science, 1890-1970*

Elizabeth Hanson, *The Rockefeller University*, *Women Scientists at the Rockefeller Institute: A Collective Biography*

Chair: Amy Slaton, Drexel University

ORGANIZED BY: Abha Sur, Massachusetts Institute of Technology

Spaces of Health and Illness

*Session cosponsored by the American Association for the History of
Medicine*

(Regency Centre)

Conevery Bolton Valencius, *Washington University*, *Inside, Outside, Valley, Field: Miasmas and Healthy Places in the Antebellum U.S.*

***Gregg Mitman**, *University of Minnesota*, *Hay Fever Holiday: Health, Leisure, and Place in Gilded Age America*

Scott Kirsch, *University of North Carolina, Chapel Hill*, *Harold Knapp and the Ad Hoc Working Group on Radioiodine in the Environment: Contested Spaces*

Michelle Murphy, *Max Planck Institute for the History of Science*, *Buildings for Bodies: Ordinary Places, Chemical Exposures, and the Politics of (Im)Perceptibility in the Late Twentieth Century U.S.*

CHAIR AND COMMENTATOR: Christopher C. Sellers, SUNY, Stony Brook

Constructing Cells and Growing Organisms

Topics in the History of Cytology and Developmental Biology I

(Regency West)

Frederick B. Churchill, *Indiana University*, *Situating a New Science: Boveri and the Embryological Analysis of Chromosomes*

***Marsha L. Richmond**, *Wayne State University*, *Cell Theory on the Eve of Genetics*

James E. Strick, *Arizona State University*, *The Cell and the Origin of Life: H. C. Bastian's Ideas, 1880-1915*

Susan B. Spath, *University of California, Berkeley*, *A New Cell Theory in 1962: The Prokaryote/Eukaryote Distinction*

CHAIR: Richard M. Burian, Virginia Polytechnic Institute and State University

Saturday, 4 November

9:00 a.m.—11:45 a.m.

**indicates session organizer(s)*

**Astronomy and Its Histories: A Session in Honor of Owen Gingerich
(Plaza East)**

Robert S. Westman, *University of California, San Diego*, Kepler's Early Astrological Problematic

Sara Schechner, *Harvard University*, Material Culture of Astronomy in Daily Life: Sundials, Science, and Social Change

***James R. Voelkel**, *Johns Hopkins University* and **Owen Gingerich**, *Harvard University*, Giovanni Antonio Magini's 'Keplerian' Tables of 1614 and Their Implications for the Early Reception of Keplerian Astronomy

Joann Eisberg, *University of California, Santa Barbara*, Making a Science of Observational Cosmology: The Cautious Optimism of Beatrice Tinsley

COMMENTATOR: Owen Gingerich, Harvard, Smithsonian Center for Astrophysics

CHAIR: Richard L. Kremer, Dartmouth College

**North-South Scientific Relations During the Cold War
(Plaza Centre)**

***Tanya J. Levin**, *Johns Hopkins University*, Winning the Hearts and Minds of Third World Peoples: US Oceanography During the Cold War

Hebe Vessuri, *Venezuela Institute of Scientific Research*, Venezuelan Oil and the Building Up of National Science and Technology in the Cold War

***Alexis De Greiff**, *Imperial College and the National Astronomical Observatory of Colombia*, The North-South Exchange Viewed from the Boundary: Abdus Salam's Conception of Scientific Internationalism During the Cold War

COMMENTATOR: John Krige, Georgia Institute of Technology

CHAIR: Zuoyue Wang, California State University, Pomona

Saturday, 4 November

1:30 p.m.—3:10 p.m.

**indicate session organizer(s)*

**Laboratory Science and Contingent Knowledge
in American Veterinary Medicine
(Brighton)**

Philip M. Teigen, *National Library of Medicine*, Science, Society, and Culture in the Establishment of the Harvard School of Veterinary Medicine

Olivia Walling, *University of Minnesota*, The Intellectual and Social Life of Nineteenth Century Laboratory Methods, A Longhorn View

***Susan D. Jones**, *University of Colorado*, Creating a Scientific Context for Contingent Knowledge in Veterinary Medicine

COMMENTATOR AND CHAIR: Barbara Rosenkrantz, Harvard University

**Forging Alchemical Identities:
Strategies for Legitimizing Authority in Early Modern Alchymia
(King George)**

Tara E. Nummedal, *Stanford University*, Gender, Authority and the Alchemical Career of Anna Maria Zieglerin

Hereward Edmund Tilton, *University of Queensland*, Count Michael Maier and the 'Imposture' of Rosicrucianism: Defending Alchemy in a Virtual Arena

***Margaret D. Garber**, *University of California, San Diego*, Legitimizing Magic in Post-Rudolfine Prague: The Role of Light in the Alchemical Philosophies of Marcus Marci von Kronland

CHAIR AND COMMENTATOR: Deborah Harkness, University of California, Davis

**Science and Race in the 20th Century
(Plaza East)**

Shang-Jen Li, *Wellcome Institute for the History of Medicine*, Woman and Worm: Gender and Patrick Manson's Parasitological Research

Peder J. Anker, *Harvard University/University of Oslo*, Holism and Ecological Racism: The History of South African Human Ecology

John P. Jackson, *University of Colorado, Boulder*, The Scientist as Social Activist: The Career of Robert E. Kuttner, 1951-1982

Lisa H. Weasel, *Portland State University*, Race and Gender through the Microscope: A Feminist Perspective on Henrietta Lacks and the HeLa Cell Line

CHAIR: Hamilton Cravens, Iowa State University

**Ancient and Medieval Natural Knowledge and Practices
(Plaza Centre)**

Karin Tybjerg, *University of Cambridge*, Wonder Making and the Rhetoric of Wonder in Hero of Alexandria

Gerardo V. Aldana, *Harvard University*, (Re-)Creation in Classic Maya Times: Astronumerology and Secret Knowledge in Kan Balam's

Mary K. K. Yearl, *Yale University*, The Time of Bloodletting

Alain Touwaide, *Independent Scholar*, Arabic Science in Byzantium: The Case of Botany

CHAIR: Joan Cadden, University of California, Davis

**Philosophy and Mind in the 18th and 19th Centuries
(Balmoral)**

Benjamin W. Redekop, *Kettering University*, Thomas Reid and the Problem of Induction: From Common Experience to Common Sense

LeeAnn Hansen, *California State University, Fullerton*, Constructing a Public Psychology: Karl Philipp Moritz and the *Magazin zur Erfahrungsseelenkunde*

André R. LeBlanc, *CIRST, Université du Québec à Montréal*, On Negative Hallucinations and the Origins of the Unconscious

Alan W. Richardson, *University of British Columbia*, The Insecure Path of a Science: Kant and the Rethinking of Logic in the 19th Century

CHAIR: Margaret Schabas, York University

Saturday, 4 November

1:30 p.m.—3:10 p.m.

**indicate session organizer(s)*

Displaying Biomedical Authority in Modern Anglo-American Culture

*Session cosponsored by the American Association for the History of
Medicine*

(Prince of Wales)

Erin H. McLeary, *University of Pennsylvania*, War Pathologies/the Pathology of War: Museum Collecting in the First World War

Ock-Joo C. Kim, *Harvard University*, Knowledge Out of Suffering: Harvey Cushing's Brain Tumor Registry

Marianne P. Fedunki Stevens, *Institute for History and Philosophy of Science and Technology*, Malaria and 20th Century Medicine: Fighting Disease with Film, 1940-2000

CHAIR: Rima Apple, University of Wisconsin, Madison

Constructing Cells and Growing Organisms

Topics in the History of Cytology and Developmental Biology II

(Plaza West)

***Manfred D. Laubichler**, *Princeton University*, From a Developmental Point of View: Theories of Development in the Conception of Theoretical Biology

Jane Maienschein, *Arizona State University*, On the Organism in Development and Heredity

Michael Dietrich, *Dartmouth College*, Johannes Holtfreter and the Politics of Gastrulation

Sabine Brauckmann, *University of Muenster*, Chemical Embryology: The Search for the Organizer

CHAIR: Gerald L. Geison, Princeton University

Physics in 20th-Century Europe:

From the Classical World to the Quantum Universe

(Regency Centre)

Robert G. Arns, *University of Vermont*, Persistence of Belief in a Mechanical Ether in the Twentieth Century

Theodore Arabatzis, *Dibner Institute, Massachusetts Institute of Technology, and University of Athens*, The "Discovery" of the Electron and the Atomism Debate

Scott D. Tanona, *Indiana University*, Bohr's Correspondence Principle: Deducing Atomic Structure from Spectral Phenomena

Frans H. van Lunteren, *Utrecht University*, Paul Ehrenfest and Dutch Physics in the Interbellum Period

CHAIR: J. C. Evans, University of Puget Sound

**Theory Comes West:
The Beginnings of Theoretical Astrophysics in Western America
(Regency West)**

David H. DeVorkin, *National Air and Space Museum, Smithsonian Institution*,
Bringing Theory to Mount Wilson in the 1920s

Donald E. Osterbrock, *University of California, Santa Cruz*, Herman Zanstra,
Donald Menzel, and the Zanstra Method of Nebular Astrophysics

***Karl Hufbauer**, *University of California, Irvine*, J. Robert Oppenheimer's
Path to Black Holes

COMMENTATOR: Robert Smith, University of Alberta

CHAIR: Peggy Kidwell, National Museum of American History, Smithsonian
Institution

Saturday, 4 November

3:30 p.m.—5:30 p.m.

**indicate session organizer(s)*

**Science in National and Transnational Contexts
(Regency Centre)**

Jorge Canizares Esguerra, *SUNY, Buffalo*, Postcolonial Nature: Nature
Narratives and Nation-Building in 19th-Century Latin America

Eckhardt Fuchs, *Max Planck Institute for the History of Science*, The
Mechanics of Transnational Science: The Escuela Internacional de Arqueología
y Etnología Americanas (EIAEA) and the Scientific Exploration of Pre-
Columbian Mexico

***Fa-ti Fan**, *Max Planck Institute for the History of Science*, Nature and
National Narratives in Early Twentieth-Century China

Juliette Chung, *Harvard University*, Transnational Science: the Japanese
Establishment of Shanghai Natural Science Institute and the Knowledge of
Taxonomy in China, 1923-1945

CHAIR: Harold J. Cook, Wellcome Institute for the History of Medicine

**The Science and Spectacle of Man:
Popularization and Professional Debates in American Anthropology
(Prince of Wales)**

Kevin J. Francis, *University of Minnesota*, Popularization and the Role of
Humans in late Pleistocene Extinctions, 1927-1957

Juliet M. Burba, *University of Minnesota*, Collecting for "The Science of
Man": Expeditions and Expositions in Physical Anthropology

Michael F. Robinson, *University of Wisconsin*, Chicago's Eskimo Village:
Reconsidering Race at the World's Columbian Exposition, 1893

COMMENTATOR: Henrika Kuklick, University of Pennsylvania

CHAIR: Alison Wylie, Washington University

Saturday, 4 November

3:30 p.m.—5:30 p.m.

**indicate session organizer(s)*

**Biology, Sexuality, and Morality in Modern France
(Regency West)**

Anne C. Vila, *University of Wisconsin*, Sex, Procreation, and the Scholarly Life from Tissot to Balzac

Kathleen A. Wellman, *Southern Methodist University*, Biology and Sexuality Morality in the French Enlightenment

***Elizabeth A. Williams**, *Oklahoma State University*, The Scientific Discourse of Hysteria in Enlightenment France

Chair and Commentator: Robert A. Nye, Oregon State University

**Modern Science and the Clergy
(Plaza West)**

John Stenhouse, *University of Otago*, Protestant Missions and Modern Western Science, 1790-1930

William A. Durbin, *Washington Theological Union*, Rome's Second Galileo: Father John Zahm's Abortive Synthesis of Evolution and Faith

Edward B. Davis, *Messiah College*, Science and Religion, Chicago Style: Liberal Protestants and Science in the Age of Bryan

COMMENTATOR: David A. Hollinger, University of California

CHAIR: Mark A. Kalthoff, Hillsdale College

**North Sea Passage: Cross-Channel Scientific Currents, 1780-1850
(King George)**

Trevor H. Levere, *Institute for the History and Philosophy of Science, University Toronto*, Cosmopolitan Isolates at Home and Abroad: Chemists and Physicians in the 1780s and 1790s

Phillip R. Sloan, *University of Notre Dame*, German Biology Comes to London: The Role of the College of Surgeons, 1814-1840

Petra Werner, *Berlin-Brandenburg Academy of Arts and Sciences*, Composing the Picture of Nature, or Alexander von Humboldt's English Correspondents

CHAIR AND COMMENTATOR: *Philip F. Rehbock, University of Hawaii

**Amateurs of Science in Early Modern Europe
(Plaza East)**

William Eamon, *New Mexico State University*, 'Amateur Science' in the Piazza: The Scientific Underworld of Sixteenth-Century Italy

Lisa T. Sarasohn, *Oregon State University*, Samuel Sorbiere: Amateur and Broker of Science

Mordechai Feingold, *Dibner Institute*, Amateurism and Science: A Reevaluation

COMMENTATOR: Andrea Carlino, Institut Louis-Jéantet d'Histoire de la Medecine

CHAIR: Joella Yoder, Independent Scholar

**Uncle Sam in the Laboratory:
Biomedical Science and the Federal Government**

*Session cosponsored by the American Association for the History of Medicine
(Brighton)*

***Buhm Soon Park**, *National Institutes of Health, More Academic Than a University: Three Freedoms and the Laboratory of Molecular Biology at NIH, 1961-1981*

John P. Swann, *Food and Drug Administration, Institutionalizing Regulatory Science and Research in the FDA*

John L. Parascandola, *Public Health Service, Science and Sex: The Venereal Disease Education Campaign of the U.S. Public Health Service in World War II*

Caroline C. Hannaway, *National Institutes of Health, NIH Scientists and International Understanding of the Spread of HIV*

CHAIR: Victoria Harden, National Institutes of Health

**Mechanics and Imagery
(Lord Byron)**

David McGee, *University of Toronto / Max Planck Institute for the History of Science, William Petty's Double-Bottom*

***Wolfgang Lefèvre**, *Max Planck Institute for the History of Science, Drawings in Ancient Treatises on Mechanics*

Marcus Popplow, *University of Bremen / Max Planck Institute for the History of Science, The Role of the Engineer Drawings in the Emergence of Classical Mechanics*

CHAIR AND COMMENTATOR: Bert S. Hall, University of Toronto

**Exhibiting the Evanescent in Victorian Science and Technology
(Plaza Centre)**

Nani N. Clow, *Max Planck Institute for the History of Science, 'Should We Trust the Expert?': Re-examining the Debates Concerning Scientific Credibility, Expertise, and Method in Late-Victorian Psychological Research*

Iwan R. Morus, *Queen's University, Belfast, Mastering the Invisible: Technologies of the Unseen at the Mid-Victorian Exhibition*

***Richard J. Noakes**, *University of Leeds, 'Imponderables in the Balance': Rewriting the History of Victorian Physics and Psychological Research*

COMMENTATOR: Otto Sibum, Max Planck Institute for the History of Science

CHAIR: Bruce J. Hunt, University of Texas



**HISTORY OF SCIENCE SOCIETY
DISTINGUISHED LECTURE**

Mary Jo Nye
Oregon State University

**“The Cultural and Political Sources of Science
as Social Practice”**

Introduction: Diana Barkan
California Institute of Technology



Mary Jo Nye, Oregon State University

**Saturday 4 November
6:00 p.m.—7:00 p.m.
Hyatt Regency Vancouver
Regency Centre**

Saturday, 4 November
6:00 p.m. 7:00 p.m.
(Regency Centre)
HSS Distinguished Lecture

Saturday, 4 November
8:00 p.m.—10:30 p.m.
Banquet
(Regency West)

Sunday, 5 November
9:00 a.m.—11:45 a.m.
**indicate session organizer(s)*

**Computer Simulations as Evidence, Experiment, and Argument:
 Historical and Philosophical Perspectives**
(Seymour)

- Evelyn Fox Keller**, *Massachusetts Institute of Technology*, Models and Simulations
 ***Naomi Oreskes**, *University of California, San Diego*, Computer Models and
 The Rise of Prediction in the Earth Sciences
Dale Jamieson, *Carleton College*, Managing Planet Earth: The Rise of Coupled
 Models and Integrated Assessments
Daniel Haag, *University of Hohenheim, Stuttgart*, Ecosystem Simulation:
 Dynamical State Systems vs. Self-Modifying, Historical Systems
 ***Mary S. Morgan**, *London School of Economics and University of Amsterdam*,
 Thought Experiments and the Generation of Economic ‘Evidence’
 CHAIR: *Naomi Oreskes, University of California, San Diego
 CO-CHAIR: Mary S. Morgan, London School of Economics and University of Amsterdam

Psychology, Popularization, and the Public
Session cosponsored by the Forum for the History of Human Science
(Balmoral)

- Benjamin Harris**, *University of Wisconsin, Parkside*, Tabloid Psychology,
 1920-1940: Did Superstition Win?
Leila Zenderland, *California State University, Fullerton*, Of Mice, Men, and
 Mercy-Killing: Steinbeck’s Novel and the Euthanasia Debate
Hans Pols, *University of New Hampshire*, Teaching Adjustment:
 Undergraduate Psychology Courses in Human Development, 1920-1960
Mark A. Eddy, *University of Oklahoma*, Educating the Individual: Competing
 Visions of the Self and Calls for Educational Reform
 COMMENTATOR: Kathleen W. Jones, Virginia Polytechnic
 CHAIR: Katharine Pandora, University of Oklahoma

Sunday, 5 November

9:00 a.m.—11:45 a.m.

**indicate session organizer(s)*

**Resurrecting Physical Theory:
Approaches to Theory Construction, 1700-1970
(Stanley)**

Mary Terrall, *University of California, Los Angeles*, Vis Viva Revisited

Mi Gyung Kim, *North Carolina State University*, Genealogy, Memory, and the Chemical Table

***Michael D. Gordin**, *Harvard University*, A Hierarchy of Sorts: D. I. Mendeleev and the Periodic Table

David Kaiser, *Massachusetts Institute of Technology*, A Wing and a Prayer: Roger Babson and the Rediscovery of General Relativity, 1948-1968

CHAIR AND COMMENTATOR: M. Norton Wise, Princeton University

**Proprietary Knowledge in Biomedical Science and Industry, 1890-
Present
(Plaza East)**

Jack Wilson, *Washington and Lee University*, U.S Patents on Organisms Prior to Diamond v. Chakrabarty

***Nicolas Rasmussen**, *Independent Scholar*, Steroids at War: Biomedical Researchers, the Pharmaceutical Industry, and the Hormones of the Adrenal Cortex, 1940-1946

Mark Cortiula, *University of New South Wales*, The Science of Separation: America's Contribution to Australia's Post-War Blood Fractionation Program

Christophe Lecuyer, *Dibner Institute for the History of Science and Technology*, Instrumentalizing Medicine: Physics Research, Medical Practice, and the Development of Linear Accelerators for Cancer Therapy at Stanford University and Varian Associates, 1952-1975

Rachel A. Ankeny, *Davis Center for Historical Studies, Princeton University*, Public Versus Private Knowledge: The Historical Evolution of Community Standards for Data Sharing in the Human Genome Project
CHAIR: Paul Theerman, National Library of Medicine, National Institutes of Health

**Method in the 19th-Century Physical Sciences
(Grouse)**

Sungook Hong, *University of Toronto*, 'One Faith, One Weight, One Measure': Language and the History of Units and Standards

Peter J. Ramberg, *Max Planck Institute for the History of Science*, Making Instruments "Transparent" in Organic Chemistry: The Case of Halogen Addition Reactions

Andrea I. Woody, *University of Washington*, Brodie's "Calculus": A Chemistry with No Future as Window onto the Past

David A. Pantalony, *University of Toronto*, Bringing Sound Into the Laboratory: The Visual Analysis of Compound Tones

Matthias Doerries, *Max Planck Institute / University of Strasbourg (Louis Pasteur)*, Self-Effacement and Objective Knowledge: Henri-Victor Regnault

CHAIR: Ken Caneva, *University of North Carolina, Greensboro*

**Putting Nature on Show in Early Modern Europe
(Plaza West)**

Michael John Gorman, *Dibner Institute for the History of Science and Technology*, Johannes Kepler and the Death of Painting

Janice L. Neri, *University of California, Irvine*, The Visual Rhetoric of Insect Illustration: Technology and Visuality in the Seventeenth Century

***Nicholas Dew**, *Cambridge University*, The Menagerie of Versailles and the Visualisation of Nature

Simon R. E. Werrett, *Max Planck Institute for the History of Science*, An Odd Sort of Exhibition: Spectacles of Science and the Russian State in the Eighteenth Century

CHAIR AND COMMENTATOR: TBA

**Galileo's Optics
(Plaza Centre)**

Eileen Reeves, *Princeton University*, Galileo and the Reflecting Telescope: Some Speculation

***Sven Dupre**, *Ghent University*, Galileo, Optics and the Pinelli Circle

Yaakov Zik, *University of Haifa, Israel*, Beyond the Naked Eye

A. Mark Smith, *University of Missouri, Columbia*, Galileo's Telescope: Theoretical Implications

Filippo Camerota, *Venice University School of Architecture*, The Portrait of the Moon: Linear Perspective and the Scientific Representation of the Celestial World

CHAIR: Albert Van Helden, *Rice University*

**Darwinian Heresies
(Cypress)**

***Abigail J. Lustig**, *Max Planck Institute for the History of Science*, Natural Atheology and Evolutionary Explanations of the Origins of Religion

Michael Ruse, *University of Guelph*, How Darwinian is neo-Darwinism?

Stephen G. Alter, *Gordon College*, Unconscious Selection and Darwin's Distribution Thinking

Robert N. Proctor, *Pennsylvania State University*, When did Humans become Human? The Impact of Racial Liberalism on the Recognition (and Denial) of Fossil Hominid Diversity 1944-2000

CHAIR AND COMMENTATOR: John Beatty, *University of Minnesota*

HSS ABSTRACTS

The following abstracts for HSS sessions appear as they were submitted, with some minor exceptions. Due to space limitations, paragraph breaks within each abstract were eliminated. Also, some submissions were difficult to read and some words may have been inadvertently altered. To promote accuracy, the abstracts were posted on the society's Web site, and authors were encouraged to check that their original wording survived intact. The varying length of the abstracts is due to the fact that some authors exceeded the space allotted on the paper proposal form. Authors were encouraged to limit their abstracts to **250 words or less**. The History of Science Society also requests that future presenters to use the Society Web site to submit their paper proposals. This saves time for all involved. We thank the organizers, presenters, commentators, and all those involved whose work ensures the success of the annual meeting.

Gerardo V. Aldana *Harvard University*

Re-Creation in Classic Maya Times:
Astronumerology and Secret Knowledge in Kan Balam's Court

Despite the fact that the calendric and mathematical elements of ancient Maya knowledge were the first-understood of their intellectual achievements and that the bulk of this material was deciphered by the early decades of this century, the extent of an "History of Mayan Astronomy" remains one paragraph in Floyd Lounsbury's 1978 *Dictionary of Scientific Biography* entry. This is particularly unfortunate for the history of science as a discipline since Maya culture allows for serious consideration of the question of 'science' in a 'non-Western' culture. This paper constitutes a first attempt at precisely this type of investigation by examining a development in Mayan astronomy in which mathematical innovation complemented political necessity. That is, Kan Balam II, heir to the throne of Palenque during the seventh century A.D., faced a legitimation crisis with the recent demise of two allies, Tikal and Teotihuacan. To ensure a trouble-free accession he developed an analogy between his immediate family and the mythic first family of Creation. This analogy he presented in monumental architecture, palatial art, and the astrology of his court. The latter was possible because earlier that century, one of his father's court astrologers had discovered how to compute the positions of the planets in their arithmetic cycles for periods of thousands of years. This astrologer then was able to correlate the events of the mythic past into the Long Count calendar relative to contemporary times. Such a feat enabled Kan Balam to tie his own ceremonies numerologically to those of the gods. Simultaneously, this feat opens up for us a window into the Maya conceptualization of time and the celestial bodies that cannot be adequately captured by 'Western'-derived disciplinary categories. We are thus forced, I argue, to reconsider our understandings of "Other" cultures as well as that of pre-modern European culture.

Ken Alder *Northwestern University*

PASCAL DEFEATS NEWTON!
Or Originality and Verisimilitude in History and Science

This paper invokes the “Pascal-Newton” forgeries to explore the transformation of the historical discipline into a “science” in France in the late nineteenth century, and the role of the history of science in this transformation. As such, the paper is a contribution to the history of proof and evidence in diverse disciplines and cultural contexts. In particular, it examines the relationship between the concurrent marketplace craze for “authentic documents” and the rise of professional history-writing based on a critical analysis of texts. The forgeries themselves were a set of 30,000 letters purchased by the prominent French mathematician (and amateur historian of science), Michel Chasles. These letters included a correspondence between Blaise Pascal and an eleven-year-old school-boy named Isaac Newton, proving that Newton had stolen from Pascal his demonstration of the law of universal gravitation. Proved this, at least, to the satisfaction of several members of the French academy, who invoked it as further proof of how French priority/originality had been once again neglected. Other academicians, however, and many more savants outside its walls, including of course many in England, were more dubious. The ensuing polemic, which lasted for three long years (1868-1870), reveals the difficulties faced by scientists (and historians of science) when they tried to bring the methods of scientific verification to bear on the art of verisimilitude by which we represent the past. To bring these difficulties home to contemporary historians, this conference paper will take the form of a pseudo-letter from the hand of the guilty forger (Vrain-Lucas) in which he defends his compositions as merely a “dramatization” of historical events based on extracts from original documents, a dramatization which he hoped would capture both the inner-workings of a remote historical period and the attention of an otherwise-preoccupied public (as well as earn him a small fortune). As a particular kind of dramatization, this conference paper is meant to challenge our own concepts of authorship and originality in history, as well as in science.

Jennifer K. Alexander *University of Minnesota*

Engineers, Charlatans, and Progressive Efficiency

Few people spoke of efficiency at the turn of the twentieth century, in the early days of American progressivism. The term remained technical, used by physicists and engineers to discuss particular aspects of thermodynamics. By the time the progressive era waned, however, efficiency had become one of America’s most recognizable slogans. Scholars have found progressive interest in efficiency superficial and portray it as an empty vessel ready and willing to carry all sorts of contextual baggage. Historians have even called some popularizers of efficiency

charlatans, arguing that they misappropriated and attenuated what had been a limited and useful concept. Even popularizers, however, used the standardized and formal measurement of efficiency, the percentage, a standard mathematically precise and yet devoid of content. This measurement, the efficiency percentage, retained the technical features of the concept. This paper discusses the role of the efficiency percentage in two different and widely circulating journals of the early twentieth century: *Engineering Magazine* and *The Independent*. It argues that efficiency experts adopted the technical standardized measurement of efficiency and developed a precise and parallel social equivalent, which was neither a metaphor nor simply a rhetorical device. It takes exception to the prevalent emphasis on efficiency as a cultural artifact more expressive of the progressive social ethos than of its own scientific and technological heritage.

Stephen G. Alter *University of Notre Dame*

Unconscious Selection and Darwin's Distribution Thinking

This paper explores the nexus between Charles Darwin's concept of unconscious selection and what I call his "distribution thinking," a subset of Darwin's population thinking as described by Ernst Mayr. Darwin never fully articulated the linkage between these two concepts, yet he increasingly connected them in his correspondence, in revised editions of the *Origin of Species*, and in *The Descent of Man*. He did this, I argue, in an effort to compensate, by analogy, for his imperfect grasp of the normal distribution of any given variation existing at a particular point in time. Although Darwin built his natural selection theory implicitly on the idea of a normal range of variations, he undercut this theme by suggesting (*Origin*, ch. 4) that nature produced "favorable" variations only rarely. He then addressed this perceived obstacle by suggesting that the presence of a large population (analogous to the conditions producing unconscious selection) increased the chance of useful variations appearing at a given time. The real issue, however, was not the chance of useful variations arising at a given time—what Darwin misleadingly suggested—but the chance of their being included in a given population sample. Ideally, a full range of variations always exists, according to the distribution principle, yet it is not necessarily represented in every actual sample. Darwin was therefore right to emphasize large populations as a condition favorable to selection. Yet he was logically inconsistent in saying that the chance of their appearing could be increased even while affirming their inherent rarity. Darwin often responded to critics on this and related issues (A. R. Wallace, Fleeming Jenkin, and Moritz Wagner) with appeals to the unconscious selection analogy, for this, he felt, provided a gestalt picture of selection working on a large range of variations, even without the aid of geographic isolation. My paper builds upon yet differs from histories of these controversies written by Peter Bowler, Frank Sulloway, and Susan Morris.

Katharine Anderson *York University*

Instincts & Instruments

By the end of the eighteenth century, the naturalist Francois Huber and other observers had amassed impressively detailed information about the behavior of bees, in part thanks to artificial hives that quite literally shed light into the recesses of the apiary. Victorian writers transformed those observations into accounts for an industrial age. Figured as a tiny geometrician and engineer, the bee embodied a natural precursor to the technical and scientific accomplishments of modern society. In its enviable and natural precision, the complex instinctive behavior of some lower forms of life prefigured and even surpassed the heights scaled by rational man. In many ways, these tributes merely re-wrote what were essentially familiar parallels between insect and human communities. But in other ways, these accounts of bees and other insects raised new concerns about both the nature of instruments and animal sensibilities. In an age which struggled with the religious and cultural implications of materialism (defined famously by John Tyndall in 1874 as “the doctrine of bodily instruments”) the precise operations of the bees shifted from a set piece of natural theology into unsettled and unsettling discussions of the limits of human reason and human tools.

Nancy A. Anderson *University of Michigan*

One Complex Amoeba:

Image, Imagination, Cell Theory and the Bioplasson Doctrine

In 1883 Carl Heitzmann published *Microscopical Morphology of the Animal in Health and Disease*. One reviewer noted that the book came “in the guise of a manual of normal and pathological histology”, but was “obviously intended principally to bring forward the author’s own theories.” Indeed, for years Heitzmann had opposed the “cell theory” with his own Bioplasson Doctrine. According to Heitzmann, all organisms (single-celled to complex) were composed of a continuous reticular network of protoplasm. Thus, Heitzmann concluded, the human body was “one complex amoeba.” Heitzmann’s theory evolved from various ideas put forth by his contemporaries (e.g., Rudolf Virchow, T. H. Huxley, Lionel Beale, Edward Curtis), but my talk will concentrate on reactions to the Bioplasson Doctrine, especially those of its critics. Much of the debate against the Bioplasson Doctrine revolved around issues of observation (seeing through lenses as well as the effects of biological fixers and stains) and the imagination in theory formation. One critic insists that the reticular structure of protoplasm was either a creation of the observer’s mind or the result of faulty adjustments of the microscope. Another detractor denounces the drawings Heitzmann made from tissues, asserting that “they have their prototype in the author’s imagination.” This paper will look at a

theory that emerged during the second half of the 19th century when much interest was shown in the substance most often called “protoplasm” and its possible role as the originally active substance of all life. I will use reactions to Heitzmann’s Bioplason Doctrine, essentially, itself a theory about the role of protoplasm, in order to investigate 19th century ideas concerning observation, imagination, and reason in microscopic work. I will incorporate a discussion of visual imagery as ocular evidence in my investigation of these ideas.

Rachel A. Ankeny *Princeton University*

Public Versus Private Knowledge:
The Historical Evolution of Community Standards
for Data Sharing in the Human Genome Project

The Human Genome Project (HGP) has become the largest ‘big science’ project in the history of the biological sciences. This paper will examine debates surrounding the status of data gathered through the HGP, and particularly conflicts regarding maintaining open access to the genomic sequences generated within the broader scientific community. Traditional ideals of data sharing within scientific communities have been forced to be reexamined and renegotiated in the process of the HGP. Recent pressures caused by the growth of more commercialized, private projects also aimed at sequencing the genomes of the human and other organisms have revealed the need for better historical understanding and contextualization of the development of such standards within biological communities and between public and private entities. It will be argued that various communities primarily focused on particular model organisms provided much of the initial impetus to retain the public nature of the project, in large part because many of the same scientists who were involved in early organism genome projects were also integral participants in the planning of large-scale projects within the HGP. Special attention will be drawn to various technologies and models of communication that had been historically successful in organism-based research that were applied in modified forms during the organization and development of the HGP.

Peder J. Anker *Harvard University/University of Oslo*

Holism and Ecological Racism:
The History of South African Human Ecology

This paper explores how the South African botanist, General, and politician Jan Christian Smuts used ideas of environmental holism and of the evolution of the mind to draw up a comprehensive political and scientific program for ecological research in South Africa. Smuts was known throughout his life as a

vigorous defender of human rights and of the League of Nations. Yet he was also known for ruthless suppression of native black South Africans, labor unions and political revolutionaries he is also remembered as the General who jailed Mahatma Gandhi. This apparent contradiction provides a focus for my analysis: how could someone both defend human rights and carry out a policy of racial segregation and political suppression? This paper will show that what may look like a paradox to our contemporary eyes actually was a coherent ecologically oriented politics of holism. Smuts's passion for nature, his training as a lawyer and his religious background serve as contextual explanations of his reading of natural law as a basis for civil law. These readings of law were recapitulated by 1926 in a grand theory of holism and evolution. (Smuts coined the word 'holism' in this connection). In his moral and political thinking Smuts became known also as a defender of gradualism, by which he meant that people should gain civil rights and respect incrementally according to the stage of their evolutionary development. Smuts would use these successive stages in the development of the human mind in his holistic theory of evolutionary development in general. Leading ecologists in South Africa such as John William Bews and John Phillips (who coined the term "biotic community") owe a great debt to Smuts and his politics of holism. Two aspects of this human ecological research were particularly important: the human gradualism or ecological "succession" of human personalities researched by Bews, and the concept of an ecological "biotic community" explored by Phillips. Smuts transformed this research into a policy of racial gradualism that respected local ways of life in different ecological homelands, a policy he tried to morally sanctify and promote as author of the famous 1945 Preamble of the United Nation Charter about human rights.

Theodore Arabatzis *Dibner Institute,
Massachusetts Institute of Technology., and University of Athens*

The "Discovery" of the Electron and the Atomism Debate

This paper concerns the entanglement of the "discovery" of the electron with the debate over the existence of atoms. It is a widespread view that J. J. Thomson's measurement of the charge to mass ratio of the electron in 1897 and his subsequent measurement of its charge in 1899 eliminated all doubt about the existence of this new sub-atomic entity. I have recently argued that this view is too simplistic and that the so-called "discovery" of the electron was an extended process, lasting from the early 1890s till the early 20th century, that involved scientists working in different areas, from the discharge of electricity through gases to spectroscopy and electromagnetic theory. This is an episode that has been fairly well-documented in the historical literature. However, one of its important aspects has not been adequately explored, namely its interconnection with the debate over the existence of atoms. The belief in

the existence of the electron qua sub-atomic particle presupposed a conviction in the existence of atoms. Thus, the complete assimilation of the electron in the ontology of physics would have immediate repercussions for the atomism debate. But the atomism debate remained open till the early 1910s a fact that clearly contradicts the view that the existence of the electron had been established, beyond doubt, by 1899. The aim of this paper is to explore the attitudes of the anti-atomic opposition towards the ontological status of the electron. I will argue that the investigation of the connection between the “discovery” of the electron and the resolution of the atomism debate sheds further light on both issues and helps us to understand more fully the launch of microphysics in the late nineteenth and early twentieth centuries, avoiding simplistic discovery narratives and highlighting the complexity of the legitimization and consolidation of microphysics.

Robert G. Arns *University of Vermont*

Persistence of Belief in a Mechanical Ether in the Twentieth Century

Concepts of the “aether of space” took various forms for thinkers such as Descartes, Newton, Faraday, and Maxwell, eventually becoming a mechanical medium that served to mediate “action at a distance” and to carry light and Maxwell’s electromagnetic waves. In an experimental program reported in 1887 (and continuing for many years) Michelson and Morley failed to detect the motion of the earth relative to this ether and, in 1905, Einstein’s initial paper on special relativity formulated electrodynamics in a way which made the luminiferous ether superfluous. However, as will be shown in this paper, various forms of belief in a mechanical medium persisted among prominent physicists (for example, Michelson, Planck, Lorentz, J. J. Thomson) over the next quarter century. The persistence of these beliefs will be discussed in terms of the bases for mechanistic physics and the factors leading to the decline of mechanism.

Eric H. Ash *Princeton University*

Queen v. Northumberland: Royal Mining Rights and the Dilemma of Expertise

The case of Queen v. Northumberland is a remarkable example of the manipulation of expert knowledge on the part of royal administrators, both for the benefit of the crown and for their own financial gain. In 1567, Thomas Percy, 7th Earl of Northumberland was sued by Queen Elizabeth over his refusal to allow the Company of Mines Royal, holders of a monopoly patent on royal mining rights, to mine copper ore on his private lands in the county

of Cumberland (now Cumbria), in the northwestern marches of England. Believing that copper, unlike the traditional “royal metals” gold and silver, belonged to the owner of the land where it was found, Northumberland argued in court that the Company of Mines Royal had no right to profit from mining copper which was rightfully his. The crown’s lawyers, however, asserted that the copper ore in question also contained some silver, which automatically rendered the copper mines royal property and nullified the Earl’s claim to them. The case, tried before the highest court that could be assembled in Elizabethan England, ultimately turned on the amount of silver present in the ore, leaving the Earl at a grave disadvantage. For the crown, through its domination of the Company of Mines Royal (many of whose senior shareholders were members of Elizabeth’s Privy Council), enjoyed a complete monopoly over the expert metallurgical knowledge needed to assay the ore and make any such determination. Northumberland, who lacked mining and metallurgical expertise himself and had no access to those who possessed it, was therefore unable to defend himself in court and suffered a costly and humiliating defeat as a result. This paper will examine the particular mining expertise that was so pivotal in determining the verdict, and the ways in which the crown was able to control the outcome of the trial by alternately marshaling and withholding the rare expertise they commanded.

Mitchell G. Ash *University of Vienna*

A Human Science?

Psychology as Science and Profession 1850-1970

Psychology occupies a peculiar place among the sciences, suspended between methodological demands derived from the physical and biological sciences and a subject matter extending into the social and human sciences. The struggle to create a science of both subjectivity and behavior and the interrelated effort to develop professional practices utilizing that science’s results illuminate both the formative impact of science on modern life, and the effects of technocratic hopes on science. The aim of this paper is to bring out certain common threads in this varied narrative. One of those common threads is that the history of psychology has been a continuous struggle by multiple participants to occupy and define a sharply contested, but never clearly bounded, discursive and practical field. A second common thread is that the history of psychology as a science and that of the psychological profession are inseparable, at least in the twentieth century. A third common thread is that while psychologists struggled to establish international networks, they also drew upon local traditions. As a result the contents of both the discipline and the profession have varied according to particular social and cultural circumstances in ways that do not easily conform to grand narratives of progressive knowledge acquisition and practical success.

John Barker *University of British Columbia*

Dangerous Artifacts:
A Case Study in Local and Global Negotiations
of the Meaning of Indigenous Objects

On at least seven occasions between 1903 and 1997, the Maisin people of Papua New Guinea attempted to purge their villages of ‘old things’—various artifacts made and used by their ancestors. Some objects were rescued from the earliest bonfire by a missionary and now form part of the Collingwood Bay collection in the Australian Museum. The rest were destroyed and few reminders of the past survive in the villages. This paper is occasioned by a proposal now before the Museum to mount an exhibition of past and contemporary material culture in Collingwood Bay in collaboration with the Maisin. In this paper, I draw upon archival documents and ethnographic fieldwork to trace the journey of those Maisin artifacts that survived local purges to museums and explore the implications of their proposed unveiling before a Maisin public. More specifically, I want to explore how Maisin attitudes towards ‘old things’ may have evolved through the twentieth century. The fear of old things, I will argue, is the result of a melding of missionary teachings about moral transformation with indigenous notions of the moral, particularly about sorcery and healing. The Australian Museum was a beneficiary of such attitudes at the beginning of the last century. As the new century dawns, it must deal with the legacy, just as Maisin confront their own continuing concerns with artifacts that can, in their view, kill but at the same time present a unique link with a receding past that villagers have come to cherish.

David S. Barnes *Harvard University*

Street-Level Etiologies:
The Political and Cultural Stakes of “Local Knowledge”
in French Public Health, 1880-1900

Beginning in the late 1870s, the new science of microbiology identified specific microorganisms as the true causes of many common and deadly diseases. This Bacteriological Revolution promised to remake not only medical science, but also the practice of public health. Scientific and verifiable etiologies would lead inevitably, it seemed, to carefully targeted and effective prophylactic interventions. Indeed, the records of government disease control efforts in France during the last two decades of the nineteenth century clearly show the traces of an increased attention to germs and their spread. Yet the changes in public health practice were slower and more subtle than the dizzying revolution in science might lead one to expect. In particular, the causes to which local physicians attributed specific disease outbreaks in individual communities did not always correspond in any recognizable way to the “official” etiologies of those same diseases in the laboratory or in

medical textbooks. Instead, the doctors constructed explanations of each outbreak—street-level etiologies, in effect—that gave lip service to universal causes but relied most heavily on a contextual reading of local political, cultural, and behavioral circumstances. These *médecins des épidémies* (“epidemic doctors”) were physicians appointed to serve as local disease control officers in addition to their regular professional activities. Acting as both a first line of defense against epidemics and as the eyes and ears of the state, epidemic doctors were ostensibly charged with enhancing the responsiveness of local and national authorities to health threats. Close examination of archival records from the late nineteenth century, however, reveals that the *médecins des épidémies* were also, in an important sense, political and cultural operatives. This paper will suggest some of the ways in which the “local knowledge” of public health both reflected and enacted key historical developments outside of the realm of science and medicine, including secularization, the consolidation of republicanism and national identity, and the “civilizing process.”

Mario Biagioli *Harvard University*

Inventions, Instruments, and Discoveries:
Priority and ‘Intellectual Property’ in Galileo’s Venice

This paper analyzes the systems of credit and priority adjudication that framed Galileo’s early career as an inventor, and compares them to the social system in which he later operated as a discoverer. It starts with a discussion of Galileo the inventor of devices such as water pumps, geometrical compasses, and the telescope. In particular, it looks at the 1607 legal action Galileo brought against Baldessarre Capra, whom he accused of having plagiarized his geometrico-military compass, and then at the historically specific definitions of “invention” and “inventor” that framed Galileo’s negotiations with the Venetian Senate regarding the reward and protection of the telescope. Taken together, these two cases describe the legal and financial practices available for the reward of inventions and instruments, and how they framed categories of priority, property, and plagiarism. The paper then analyzes the radical translation through which these categories were transferred from the reward of materially useful devices (such as inventions) to that of economically “useless” discoveries (such as the Medicean Stars).

Ann M. Blair *Harvard University*

Reading Strategies for Coping with Information Overload

I will examine the methods of reading designed to cope with an overabundance of books in the 16th and 17th centuries, by looking both at advice manuals on how to study and at traces of actual reading. Increased diligence, always

recommended, could not suffice. A first strategy was selection: Bacon for example recommended thoroughly digesting only a few books, and merely tasting many others hence the utility of book reviews and critical bibliographies. Another was to rely on the labor of others, either amanuenses hired to take notes or printed collections of notes of the kind one might have taken oneself (e.g. notes by abridgment or by commonplaces offered in encyclopedic reductions and printed florilegia/commonplace books respectively). Occasionally authors speak of cutting up a book to save the labor of copying from it. Extant annotations also reveal the great interest of readers in the devices that facilitated a punctual consultation of a book, especially the alphabetical index. Printers responded to reader demand by supplying increasingly sophisticated indexes, along with apologies and errata to forestall criticism.

Alexia Bloch *University of British Columbia*

Crisis or Crossroads?:

Museums in the Russian Far East Reinterpreting State Narratives

Museums play an important role around the world today as communities from the Aleutian Islands to New Zealand to New York to the Russian Far East look for innovative ways to address legacies of colonialism and reinterpret dominant paradigms underlying the representation of the “Other”. Many would say that since the 1980s museums, and especially anthropology or natural history museums, have been grappling with a “crisis of mission.” The worldwide crisis of direction for museums is particularly thrown into relief in the context of Russia, where an entire society was abruptly forced to reexamine its relationship to government, authority, and local history. This paper draws on the crisis of knowledge in Russian natural history museums to demonstrate both broad trends in the museum world, and the unique place of indigenous Siberians in their growing critique of the Soviet narrative of progress.

Stephen Bocking *Trent University*

Science, Politics, and Perceptions of the Arctic Environment

Scientists have contributed much to Canadians’ ideas about their national territory. If, as Northrop Frye has suggested, the story of humans in the Canadian landscape has been “the conquest of nature by an intelligence that does not love it,” then an essential element of this intelligence has been scientific work. Scientists have been especially significant in shaping Canadians’ attitudes towards the Arctic. The Arctic has been, for example, represented by geologists as a resource-rich frontier by ecologists, as a fragile wilderness and by climatologists and atmospheric chemists as an international commons or

“global laboratory” . Most recently, through the accumulation and application of traditional knowledge, science is reasserting the oldest image of the Arctic, that of homeland. Of particular significance is the interaction between these views of the Arctic environment, and the intellectual and institutional evolution of Canadian science since the Second World War. These views have influenced, and have themselves been influenced by, evolving scientific ideas. Views of the Arctic as, for example, a storehouse of resources, a harsh, demanding environment, a fragile wilderness, or an international commons, have also helped to justify increasing funding for northern science, and the creation of new research agencies. Demands on scientists implied by these institutions, and by the political context of these institutions—that, for example, they provide not general theory, but quantitative, testable, specific information about the Arctic environment—also illustrate how the political and social roles of Arctic science relate to scientific theory, and to the contribution of science to the formation of more general ideas about the environment.

Sabine Brauckmann *University of Münster*

Chemical Embryology: The Search for the Organizer

Experimental embryologists in the 1930s attempted to solve the crucial issue of how an embryo develops its specific shapes during ontogenesis. I will focus on Conrad H. Waddington’s first approach of the “epigenetic landscape” , and roughly sketch how Waddington, Joseph Needham and Jean Brachet among others, searched to define the chemical nature of Hans Spemann’s Organizer. I will briefly describe the transplantation experiments that Spemann and his co-workers conducted in the 1920s. These showed that a transplanted blastoporal lip could induce a nearly complete pattern of organ anlage and an axial system, a chimeric structure composed of both donor and host cells. Spemann called this the “Organizer Effect” . Hans Correns had correctly pointed out to Spemann in 1921 that the Organizer might provide for the correct sequential activation of the genes involved in development, but Spemann was never to deal with this genetic thread in his research nor terminology. Waddington’s significant point of departure was to search for the chemical nature of the Organizer, and to clarify embryonic terminology. Encouraged by the members of the Club of Theoretical Biology at Cambridge, Waddington developed a physico-chemical model for sequential morphogenesis during embryogenesis. With a ball game based on the two-dimensional equipotential systems of Hans Driesch and a topographic surface pattern as equated by Alfred Lotka, Waddington simulated embryonic differentiation in a series of steady states that resulted in the equilibrium of development. He visualised the developmental system as “canalized” and pictorially represented it by bifurcations, an epigenetic landscape of hills and valleys, the landscape (choices) changing as development progressed. Needham summarized their

experimental data in the “Biochemistry and Morphogenesis” (1942), the successor to his 1931 three-volume work “Chemical Embryology” in which he had first introduced the new area of the chemical basis of ontogeny. The essential difference to Continental experimental embryology was, however, that the British School identified the inducing agent with a biochemical attractor, the so-called masked evocator. By contrasting these two different styles of scientific thought, the talk will address some further questions, e.g., why Spemann did not incorporate the gene, or how deeply Waddington’s work relied on Bateson’s definition of genetics as the science that deals with the physiology of descent.

Michael T. Bravo *University of Cambridge*

Enlightened Precision in Geography and Anthropology

Geography was lauded as the queen of enlightenment sciences in the mid-eighteenth century cartography was her sceptre. This paper explores the resonance between the values of precision implicit in cartography and anthropology. Historians of science have tended to assume that precision is intrinsic to cartography but only metaphorically imported into the human sciences. Is this assumption of cartography’s priority justified and if so, how is it peculiar to enlightened science? I will examine the rhetorical role of precision in early nineteenth century anthropology of everyday life near home as well as far-flung places. The language of precision may tell us more about the perception of cartography than the maps themselves.

Emily K. Brock *Princeton University*

Gardeners and Botanists in the Study of Forests in England, 1650-1800

In the late seventeenth century the growth and maintenance of forests to support England’s growing commercial and naval timber needs became a serious concern. A response soon came from the Royal Society in the form of John Evelyn’s *Sylva*, a book concerned with both the technicalities of planting trees and the encouragement of private landowners to plant. As the enthusiasm for planting trees and forests grew, the need for experts in the art of silviculture became apparent. Gardeners who concerned themselves with every aspect of large estate gardens were the primary tree planters of this era, and in the years after the publication of *Sylva* their writings included ever more discussion of trees and forests. In these gardeners’ books we see a shift towards mimicry of the scientific writings of Evelyn, plant physiologist Stephen Hales, and other mainstream botanical writers. Among the most prominent gardening writers, their imitation of mainstream academic botanists was skillful enough to gain

their acceptance in scientific botany's elite inner circles. In this paper I show how the adoption of methodologies promoted by the Royal Society allowed gardeners to address silviculture in a manner which had the appearance, if perhaps not the content, of science. This spurred their acceptance both among their clients and in the field of academic botany.

Charles M. Brotman *University of Rochester*

Helmholtzian Acoustics in a Darwinian Key:
James Sully, Edmund Gurney, and the Psychology of Music in Victorian
Culture

Although it is widely known that Hermann von Helmholtz's work *On the Sensations of Tone* deeply influenced music theory in Anglo-American culture, we still know little about the reception and modification of his ideas in the second half of the nineteenth century. This paper examines the efforts of two English psychologists, James Sully and Edmund Gurney, to reconcile Helmholtz's work with evolutionary theories of mind and nature known through the work of Charles Darwin and Herbert Spencer. Writing in the years after Darwin and Spencer had themselves theorized on the evolutionary significance of music, Sully and Gurney both believed that music was important because it elicited powerful emotional feelings from men and women living in an increasingly skeptical age. Like many other Victorian scientists, in other words, Sully and Gurney sensed that aesthetic culture could function as a genuinely spiritual alternative to religion. If Helmholtz's work legitimized their quest to put music on a scientific foundation, the "law of evolution," it seemed, was still needed to account for the mysterious "power of sound."

Janet Browne *Wellcome Centre for the History of Medicine*

Discovery

One well-established way into the literature of scientific travel is to consider specific voyages. Recently we have also become accustomed to thinking of the various scientific practices in which travelers engaged, the construction of facts in metropolitan centres back home, and the pragmatic consequences of a voyager's return as seen in the possibilities he or she negotiated for creating expertise and enhancing a career. Here I would like to approach the theme from a slightly different perspective and think about the social economy of the ships themselves, in this case as laboratories. My case study is the scientific research vessel *Discovery*, first commissioned by the Royal Geographical Society for Robert Scott's National Antarctic Expedition of 1901-4. Although the ship was lavishly fitted up for scientific purposes and the voyage earned

Scott, Shackleton and Wilson lasting fame, with a wealth of significant results, its actual role was essentially a passive one as quarters for the crew. It was only during the Banzar Expeditions, 1929-31 that the British government learned how to make use of it as a floating research station.

Joshua Blu Buis *University of Pennsylvania*

The Naturalization of the Imported Fire Ants

“Dirt,” wrote Mary Douglas, “is matter out of place.” Similarly, pests are organisms out of place, viruses in a human cell, weeds in a garden, insects in a field of corn. While all pests are organisms out of place, not all organisms out of place are pests, however, nor do all achieve the status without controversy. The question, then, is not whether an organism is a pest, but, Who says so? Why? And how do they know? In the early part of the twentieth century, a population of fire ants reached Mobile, Alabama after a voyage from South America. By the late 1950s, their numbers had grown to such an extent that the ants were noticed by hunters, farmers, and politicians throughout the South. The ants stung; they destroyed crops; they seemed to kill domestic and wild animals; their mounds interfered with farm machinery. They were called pests and their out-of-placeness memorialized in their name: imported fire ants. To eradicate these pests, the USDA sprayed chemical poisons over the Southeast in the largest insect control operation in American history. The program stirred the anger of environmentalists such as Rachel Carson who objected to the use of the poisons. As part of their protests against the spraying, the environmentalists argued that the ants were not out of place, but that in the 40 years they had survived in the South the insects had become part of the ecology of America. My paper will investigate the mechanisms by which the ants were naturalized, tracing the way Carson and others developed their arguments and deployed them. I will pay attention to what evidence they accumulated and how they chose between conflicting data. The pattern that emerges illustrates that the naturalization of the ants was as much a political as a scientific process. The ants were incorporated into a balanced nature that repudiated what the environmentalists saw as the autocratic bureaucracy of the USDA. The naturalization of the ants allowed the environmentalists to move from a narrowly technical debate—over the toxicity of pesticides—to one that connected to the very definition of American democracy in the post-World War II era. In the end, then, analyzing pests engages the same issues Douglas found in her study of dirt. Both involve “reflection on the relation of order to disorder, being to non-being, form to formlessness, life to death. Wherever ideas of dirt are highly structured,” say Douglas, “their analysis discloses a play upon such profound themes.”

Juliet M. Burba *University of Minnesota*

Collecting for the “Science of Man”:
Expeditions and Expositions in Physical Anthropology, 1912-1915

This paper will focus on physical anthropologist Ales Hrdlicka’s work for the 1915-1916 Pacific-California Exposition (San Diego) and examine his use of this public arena to define and promote his discipline. In the early twentieth century, anthropologists sought to expand the institutional support for their discipline. Ales Hrdlicka, a curator at the U. S. National Museum, was often at the center of activities aimed at professionalizing and promoting physical anthropology. He founded the *American Journal of Physical Anthropology* in 1918, led the effort to form the Association of American Physical Anthropologists (which first met in 1930), and wrote countless articles for popular audiences, in addition to his copious scientific publications. During his early career at the Parisian Broca Institute, Hrdlicka saw that in Europe physical anthropology was an established and respected science, a status he hoped it might achieve in the United States. The Exposition provided Hrdlicka with an opportunity to further his plans. The organizers chose as one principle theme “The Science of Man.” Anthropological exhibits would be a centerpiece of the fair, and the Smithsonian Institution was contacted to assist in creating them. Ales Hrdlicka received \$30,000 from the Exposition corporation to carry out research and create exhibits that would become the core of the show. For Hrdlicka, this funding was a windfall. He saw the Exposition as an excellent venue to define physical anthropology and display the progress researchers had made in understanding human evolution, diversity, and individual development. Perhaps more importantly, the funding enabled Hrdlicka to direct expeditions to Alaska, the Philippines, the Ukraine, Africa, and Australia, and to personally conduct fieldwork in Peru and Siberia. The exhibition project allows me to explore the influence that Hrdlicka’s popularizing work had on his research through the funding it provided and the requirements of presenting the discipline to a general audience.

Richard W. Burkhardt, Jr. *University of Illinois at Urbana, Champaign*

The School for Naturalist-Voyagers

Among the multiple interactions between governments and museums that were so important for the growth of natural history in the 19th century, there may have been none that looked more promising at its inception than did the special “school for naturalist-voyagers” that was established at the Museum of Natural History in Paris in 1819. Proposed initially by the French Minister of the Interior, who also promised to fund the operation, the idea of the school was to train young naturalists who could then be sent off to the far corners of the globe in

search of plants, animals, and minerals useful to France and/or interesting to science. The professors of the Museum, not surprisingly, were enthusiastic about the Minister's idea, believing it would assure them of the supply of new specimens on which the progress of natural history depended. However, aligning the interests of the naturalists at the Museum with those of the French government and with a set of aspiring, young voyager-naturalists was not an entirely straightforward matter, as the voyage of discovery to Australia of Captain Baudin had illustrated less than two decades earlier (1800-1804). This paper seeks to reconstruct the diverse aims and interests of the professors of the Museum, the French government, and the candidates for the school. It then explores what became of the school after the first three naturalist voyagers sent out under the project's auspices met disaster respectively in Madagascar, the Philippines, and Puerto Rico. Particular attention is paid to the various lessons that seem to have emerged from the Baudin expedition, the diverse regions of the globe in which the Museum and the French Government after 1815 were most interested, and the recurring issue of the control of specimens.

Filippo Camerota *Istituto Universitario di Architettura di Venezia*

The Portrait of the Moon:

Linear Perspective and the Scientific Representation of the Celestial World

The paper will examine the issue of the scientific representation of the celestial world introduced with Galileo's telescope. During the 16th century, the developments of linear perspective contributed to clarifying problems associated with the representation of the Ptolemaic planisphere, and made possible the diffusion of terrestrial globes in perspectival projection (Dürer), as well as the elaboration of the new orthographic projection of Juan de Rojas. Not only did the invention of the telescope shorten astronomic distances and render feasible the geometric representation of the celestial world, but color, light, and chiaroscuro were introduced in the graphic repertory of scientific representation. It should not be excluded that the treatise *De visu et coloribus* as ideated by Galileo would have taken into account new considerations on the effect of lenses on vision. The whiteness of the moon, or the light reflected, is one of the issues to emerge from observations made by Galileo and his painter friend, Ludovico Cigoli, to whom we owe not only the first true portrait of the moon but also, the first comparison between the eye and the camera obscura that would lead to the telescopic representation of sunspots. Galileo based his explanation of sunspots and other problems related to celestial observation (comets, the rings of Saturn, the phases of Venus) on the laws of linear perspective which Cigoli had illustrated in detail in his voluminous treatise. The importance of representation in scientific research appears most evident in the debate over sunspots when one of its proponents, Christopher Scheiner, assumed as a pseudonym the name of Apelles, a famous painter in antiquity.

Jorge Canizares Esguerra *SUNY, Buffalo*

Postcolonial Nature:
Nature Narratives and Nation-Building in 19th-century Latin America.

In the nineteenth century, Latin American countries faced the challenge of building nations out of scratch while contending with a multiplicity of centrifugal forces tearing them apart. Historical narratives, we are now told, have been central to the emergence of nations as communities of citizens. Historical narratives have also proved important in their undoing. “Nature” narratives might have played a similar role by either facilitating or obstructing the consolidation of these imagined communities. The search for “typical” local, regional, and national landscapes, the surveying and mapping of territories, the study of how climate affects labor, culture, and the economy exercised the imagination of Latin Americans in the nineteenth century. I seek to explore how these processes both facilitated and impeded the emergence of the new nations.

Cong Cao *University of Oregon*

Ideology and Chinese Science

In the early years of the People’s Republic of China, scientific disciplines were claimed to carry distinctive ideological character. The Communist Party promoted one school while devaluing others from an ideological rather than a scientific standpoint. The domination of Lysenko biology and the suppression of Morgan’s genetics in China during the 1950s and 1960s are a well-documented example. The paper is going to review other cases—the ban of sociology, the criticism of Pauling’s theory of the chemical bond and the attack of Einstein’s theory of relativity, and answer the question of why ideology came into play in Chinese science. It is the Soviet influence, the difference in the training of Chinese scientists and China’s political climate that made a field proletarian or revolutionary, and bourgeois or reactionary, which resulted in the different destination for the field and for scientists working on it.

John Carson *University of Michigan*

Peace Work: Intelligence, Merit, and the Limits of Democracy

In this paper, I will examine in detail one part of this story of the co-production of notions of merit and social order, the development of the civilian group intelligence test in the United States and the reverberations its deployment and use on a mass scale engendered in the inter-war period. To its promoters, measurements of intelligence promised simultaneously to reveal one of the

fundamental characteristics of an individual's nature and to allow social decisions about that person to be made according to seemingly objective and neutral criteria. To its critics, the vogue of intelligence threatened to undercut the very premise of American democracy by naturalizing a social hierarchy and substituting the norms of a particular group for those of the whole. By investigating how this new technology for ranking and sorting the population was constructed, what effects it had when appropriated by schools, industry, and government, and what reactions it elicited, I hope to illuminate how ways of doing science and ways of doing governance intersected and informed one another. In the process, I will also examine how the dual visibilities produced by intelligence tests—the visibility of the individual to decision-making authorities and the visibility of the decision-making process to the citizenry—intertwined, and how both forms of visibility came to seem unmediated and trustworthy.

Cristina Chimisso *Open University, United Kingdom*

Hélène Metzger:

The History of Science between the History of Mentalities and Total History

This paper investigates the contribution of the historian of science Hélène Metzger (Chatou en Seine-et-Oise, France, 1889—en route to Auschwitz 1944) to the debates on the writing of history of science which took place in France in the period between the two world wars. My evaluation of her ideas results from an analysis of the discussions held at the *Centre de synthèse* the courses she gave at the Institute for history of the sciences and technology of the Sorbonne and at the *École pratique des Hautes Études*, where she replaced Alexandre Koyré her work for the International committee for history of science her correspondence with George Sarton and her own historiographical writings and her works on history of chemistry. The examination of Metzger's point of view is a way to investigate the contemporary conception of history of science as the study of the mind and as total history. The former conception institutionally derived from French history of science having its roots in Philosophy Departments, theoretically implied a conception of science as cultural production and an emphasis on the study of 'mentalities' behind that production. The conception of history of science as total history likewise recognised science as a cultural production. Moreover, it implied the necessity, as Metzger often stressed, of studying any aspects of cultural and social history in order to understand past science. Metzger's point of view on the ideas expressed in these institutions and circles are particularly interesting because of her peculiar position as a Jewish woman trying to 'conquer a real post' in academia, as she put it. Jews were only then starting pursuing academic careers in France but this applied to men, who often married Jewish wealthy women apart from a handful of illustrious exceptions, women had no positions in French universities of the time.

Anna Sofie Christiansen *University of Copenhagen*

Hermann Scherchen's Gravesano Project:
Cultural Globalization through Scientific Verification of Western Art Music

In this proposed project I shall investigate the nature of the research carried out and discussed during a series of symposia in Hermann Scherchen's studio in Gravesano, Switzerland in the years from 1954 to 1966. Till now, there has been no comprehensive study of the activities in Scherchen's Gravesano studio, and their important role in the development of music technology with the purpose to reveal the universal nature of music and music perception through science. In connection with the conferences, Scherchen published articles, reviews, etc. in the periodical *Gravesaner Blätter, eine Vierteljahresschrift für musikalische, elektroakustische und schallwissenschaftliche Grenzprobleme (1955-66)*. The papers cover topics ranging from scientific papers on acoustics and psycho-acoustics in the tradition of "Systematische Musikwissenschaft" articles on sociology, music consumption, radio and recording technology and, finally, studio reports. The ideological framework was based on Scherchen's vision of music technology as a means of fulfilling 19th-century notions of art music as a universal language and, hence, a key to global understanding. The *Gravesano* activities appear to have been rooted in an urge to develop techniques to create a music culture of the future that was based on aesthetic principles of the past. Their actual implementation through scientifically founded research were based on the principles of information theory. Institutional support was provided by UNESCO under the auspices of the International Music Council, but Scherchen also collaborated with commercial companies. This places the *Gravesano* Project in a much larger framework of cultural institutionalization and industrialization. The "Tagungen" reveal an underlying philosophy in which there is a belief that there exists one music that, through its affinity with the laws of human perception, is superior to others, and hence universal to humankind. However, the seemingly inconclusive results of the "Tagungen" do indeed serve to raise the question of whether music and science are incommensurate domains that obey rules or conventions that cannot be translated from one to the other.

Juliette Chung *Fairbank Center, Harvard University*

Transnational Science:
The Japanese Establishment of Shanghai Natural Science Institute
and the Knowledge of Taxonomy in China, 1923-1945

The Japanese establishment of Shanghai Natural Science Institute in 1923 was a product of cultural exchange and international coalition for scientific advancement such as endemic disease investigation, plague prevention and

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pharmaceutical production of Chinese herbal medicine. However, as the Institute gradually developed into an intelligence organ of the Japanese State in the times of Sino-Japanese conflicts (1928, 1931 and 1937-45), the Institute became a reality of cultural invasion and posed an imperialistic threat to the geobody of Chinese nation. Against such a historical backdrop, the knowledge of taxonomy emerged as a prioritized subject in Chinese scientific community in order to facilitate the recognition and protection of the nation's natural resources. This paper first foregrounds the international context in which the founding of the Institute was envisioned. It then analyzes the ambivalent sentiments and positioning between the Chinese and the Japanese scientists in the setting of the Institute. Subsequently, it focuses on the Chinese debate on taxonomy versus experiment within the discipline of biology, and finally concludes with the socioeconomic ramification and political implication of transnational science.

Frederick B. Churchill *Indiana University*

Bloomington Situating a New Science:
Boveri and the Embryological Analysis of Chromosomes

In this talk I intend to examine Theodor Boveri's efforts to explore the "constitution of the chromatic substance of the cell nucleus" through a series of sophisticated morphological and experimental procedures that were ostensibly a reflection of the moving frontier of the microscopical research of the day. His investigations drew together a broad range of loosely connected biological phenomena into a new conception of chromosomes. His achievements were rigorous in technique and argumentation—well beyond the standards of contemporary biology, and his results became the foundation of what is now known as "classical genetics". At the height of his career Boveri presented his research as a new science, which he described as the "Embronalanalyse des Zellkerns." Its procedural details, however, turned out to have only short term implications for the development of genetics and embryology.

Jonathan Clark *University of Kent at Canterbury*

History from the Ground Up:
Bugs Political Economy and God in Early Nineteenth Century Britain

Long regarded as a hierarchical, organic model of society, the bee-hive—
together with ant and termite colonies—became more than the traditional
preserve of monarchists in the late eighteenth century. Social insects supplied
important evidence for Enlightenment values that challenged the hierarchy in

nature and society. As natural history metamorphosed into a history of nature, the habits, instincts, and intelligence of insects threatened to blur or extinguish the distinction between man and beast. Combined with a renewed commitment to a hierarchical Natural System of classification, the concern with the divide between instinct and intelligence elevated the status of insects in natural history discussions. Through an exploration of the interconnections of physiocracy, quarianism, and instinct/intelligence disputes, this paper examines the manner in which partisan sectarianism shaped perceptions of the natural world in the ‘age of revolutions.’

Nani N. Clow *Max Planck Institute for the History of Science*

“Should We Trust the Expert?”:

Re-examining the Debates concerning Scientific Credibility, Expertise,
and Method in late-Victorian Psychical Research

This paper examines changing approaches to psychical research within the British Society for Psychical Research (SPR) from the 1880s to the 1920s. Taking their cue from the experimental researches on psychic phenomena of such scientists as William Barrett and William Crookes during the 1860s and 1870s, the Society for Psychical Research (established in 1882) was modeled explicitly on the Royal Society with the purpose of “producing and examining [psychic] phenomena as it were in a laboratory.” Aiming to integrate “scrupulous honesty” with “painstaking precision,” the SPR recruited scientists—and especially physicists—to serve as investigators for their researches on phenomena which ranged from thought-transference to spirit manifestations. Thus, in the early years of the SPR, its existence, overwhelming emphasis was placed upon the credibility, experimental methods and apparatus employed by investigators such as Oliver Lodge, J. J. Thomson, and Lord Rayleigh. Until the final years of the century, scientists were crucial to the undertaking of psychical research for two reasons. First, they were most capable of exporting experimental apparatus as well as research techniques into the seance room. Second, scientists were considered—by the nature of their profession—highly qualified as honest and precise observers above the suspicions of collusion or confederacy in the case of fraud. However, by the turn of the century, this position came to be challenged from both within and outside of the SPR. The SPR investigator J. G. Piddington and the arch-skeptic Dr. Charles Mercier both argued that the methods of scientific investigation and observation did not necessarily imbibe the scientist with the skills or ability to investigate psychic phenomena. By the 1900s, the arguments that had been used to establish the SPR as a scientific organization and that had led scientists to hold a privileged position in psychical research, were exactly the arguments used against them by critics such as Mercier. This paper will examine this shift, and the controversies surrounding it, from several aspects. First, it will

examine the detailed debates within the SPR concerning scientific method and the use of apparatus that arose around, for example, the exposure of the fraudulent medium Eusapia Palladino in the mid-1890s. Investigators such as Oliver Lodge and Henry and Eleanor Sidgwick began to reexamine their positions concerning the integration of apparatus into experimentation on the phenomena. Standard uses of technologies in psychical research had focused on both measuring effects and controlling the medium. Oliver Lodge and the conjurer J. N. Maskelyne explored the ways in which experimental apparatus could be used against investigators to produce fraudulent effects—leading Lodge to conclude that uses of technology in investigation might distract the observer more than assuring the validity of results. In conjunction with this, debates concerning the relative validity of spirit photography in the 1920s brought issues of the use of apparatus and instruments in psychical research to the fore. Scientists like Lodge, who had been at the forefront of improving the apparatus, films and techniques of x-ray photography for both diagnostic and research purposes, flatly rejected the utility of photography for the recording of spirit phenomena. Finally, this paper will conclude with the argument that a renaissance of the experimental techniques, methods, and apparatus employed by the SPR in the 1880s and 1890s (when its research program emphasized the implementation of experimental technologies) occurred in the 1920s and 1930s. Research programs based at Duke, Princeton, and the University of Pennsylvania explicitly drew upon the technologies and methods employed by the SPR to investigate psychic phenomena.

Deborah R. Coen *Harvard University*

Taking Nature's Pulse: The Place of the Organic in Austrian Physics

In answer to his question “What is Life?” Erwin Schrödinger located the uniqueness of living things in the balance between the persistence of their general forms and their potential for random variation. This vision of variability as the signature of the organic will be the focus of my talk. In the nineteenth century, writers in German from Goethe and Schelling to Houston Stewart Chamberlain sought the essence of the organic in nature's fluctuations—from the rise and fall of a barometer, to changes in seasonal temperatures from year to year, to physical variations between members of the same species. My talk will consider how nature's fluctuations turned from a literary trope associated with *Naturphilosophie* into a new field of twentieth-century physics, that of *Schwankungserscheinungen*. Breaking with the firmly entrenched method of paring away the “scatter” in experimental measurements to focus on the “normal” value, Schrödinger was among a group of German-speaking physicists who came to treat fluctuations as phenomena in their own right. In radioactivity, for example, instead of imposing regularity on their measurements like colleagues abroad, Schrödinger and his Viennese collaborators mapped

out the distribution of fluctuations and looked to its graphical form for insight into the character of the process. In studies of color perception these same Viennese physicists insisted on the irreducible variability between observers. In rejecting the significance of averages and problematizing the notion experimental error, Schrödinger and his colleagues took an approach that might be termed “morphological.” The premise of their method seems to have mirrored Goethe’s axiom that there is no such thing as a “normal” member of a species, or an “error of nature.”

Jamie N. Cohen-Cole *Princeton University*

The Cognitive Revolution
and the Culture of Interdisciplinarity in Cold War America

In the two decades following World War Two experimental psychology experienced the Cognitive Revolution. Early adherents of the cognitive perspective saw their work as a fundamentally interdisciplinary project. In fact, it was this interdisciplinarity which helped cognitively oriented psychologists overcome objections raised by behaviorists such as B. F. Skinner to the scientific study of mind. But, the advantage the cognitive perspective drew from its interdisciplinary stance did not rely only upon the specific ideas that psychologists could import from neighboring disciplines. Instead, a significant part of the benefit cognitive psychology derived from being interdisciplinary rested on the two features of the Cold War’s cultural climate. First, many attributed America’s technical success in WWII to the interdisciplinary nature of the war-related research programs—most notably that of the Manhattan Project. They further believed that this war-time experience demonstrated that the best way to conduct research would be on a similar interdisciplinary basis. Second, from the late 1940s through the 1960s, thought carried political and moral significance. For many in this period rational thinking and freedom of thought were seen as intimately related and as the foundations of democracy. At the same time, irrational, ideological, and totalitarian thinking (which were commonly equated one to the other) were seen as anti-democratic. If types of thinking could be characterized with political labels, the converse was also true—political positions were given mental characteristics. Within this understanding, a primary feature of rationality was broad, synthetic thought. In the case of scientific research this meant the ability to escape methodologies bound by a single discipline. Within this charged context government officials, public intellectuals, science administrators, foundation officials, and cultural commentators would come to favor interdisciplinary research. And, as a consequence, research programs with a cognitive emphasis were able to garner external funding, despite the fact that a behaviorism opposed to cognitive perspectives held sway within the academy.

Mark Cortiula *University of New South Wales*

The Science of Separation:
America's Contribution to Australia's Post-War Blood Fractionation
Program

One of the most important advances in laboratory medicine during the Second World War was the development of blood plasma fractions as therapeutic agents. Wartime research in both Britain and the United States led to the development and adoption of two distinctive techniques for the separation and concentration of blood components (a process known as fractionation) by major pharmaceutical companies. At Harvard Edwin J. Cohn's group perfected a fractionation method based on ethanol extraction, while in England R. A. Kecwick and M. E. Mackay developed an alternative approach using ether. Although both techniques were considered for adoption in postwar Australia, this paper argues that Australia, like many other countries, primarily chose to adopt the American fractionation method because Cohn proved exceptionally willing to share scientific knowledge and technical advice with antipodean colleagues.

T. Hugh Crawford *Georgia Institute of Technology*

Filming the Event: Technology, Temporality, and the Object of Science

When teaching in science studies programs, one regularly engages, in one form or another, the rather vexed relationship between the scientific fact or object and the temporal frame from which it emerges. Students are quick to see the social, cultural, and historical context that in some way surrounds such facts, but, at the same time, are quick to place those same newly minted fact in the rarefied realm of atemporal universality. One way of engaging this problem is through detailed analysis of film popularizations of scientists and their discoveries. This paper examines two mid-century film biographies, William Dieterle's *Dr. Ehrlich's Magic Bullet* (1940) and Mervyn LeRoy's *Madame Curie* (1944) and attempts to show how those films' narratives and the technology of the cinema confound the spatialized, atemporal moment of discovery with the temporal duration of laboratory protocols and film editing techniques. A careful look at these films reveals how seemingly singular events (the isolation of the TB bacillus, the moment of diagnosis, the discovery of radium in a glowing dish) are actually Events—a term developed by Gilles Deleuze in his somewhat idiosyncratic reading of Alfred North Whitehead (*The Fold*). Through this notion of the Event (and, in *A Thousand Plateaus*, his concept of the “virtual”), Deleuze expands and explicates Whitehead's notion of how “actual entities” are a “conrescence of prehensions which have originated in the process of becoming” (*Process and Reality*). What makes

these films invaluable in a classroom is that they enact that “conrescence” and, at the same time, raise precisely the philosophical questions that prompt Whitehead’s philosophical concept.

Paul J. Croce *Stetson University*

William James on the Healing Arts

Like many nineteenth-century scientists, William James entered the formal study of nature through medical training. His only academic degree was an M.D. earned from Harvard in 1869. His work in physiological psychology in the 1860s through 1890s paralleled the professional developments in medicine toward laboratory and physiological explanation for disease, most notably the advent of the germ theory of disease. However, James maintained an ambivalence about these scientific changes within medicine. This paper will investigate James’s attraction to the alternatives to regular medicine based on his family’s practice of the popular folk medicine homeopathy through his defense of non-conventional healers in the 1890s. This paper will also be an opportunity to investigate why James went against the mainstream and also why he was so guarded in his defense of the alternatives. Remaining open to irregular medicine with its denial that health could be explained by physical and chemical operations, was a part of his rejection of scientific reductionism.

Richard D. Cunningham *Pennsylvania State University*

Moveable Visual Images and Active Reading Practices in the Education of Sixteenth-Century English Navigators

In the early modern period texts devoted to the study of natural phenomena and to mechanical arts began to integrate visual images and text to communicate their messages. Such texts include da Vinci’s *Tratado de Estatica y Mechnica En Italiano* (1493), Andreas Vesalius’ *De humani corporis fabrica libri septem* (1543), William Gilbert’s *De Magnete* (1600), and of course Galileo’s *Siderius Nuncius* (1610) and *Designe Macchie del Sole* (1612). Texts intended to educate English readers on the art of navigation similarly depended on the use of visual images to elucidate the lessons they offered. Prime examples of such are translations into English of Joannes Taisnier’s *Opusculum perpetua memoria dignissim* (1562) and Martin Cortes’ *Breve compendio de la sphaera y de la arte de navegar* (1551). Both texts were translated by Richard Eden: Taisnier’s as *A very necessary and profitable book concerning navigation* in 1579, and Cortes’ as *The Arte of Navigation* in 1561. While work has been done on the integration of text and image in early modern Europe, the similar integration in early modern England is much less studied. At the HSS 2000 conference in

Vancouver I will demonstrate the connection between text and visual image by examining a particular image and its accompanying text in early editions (1561 to 1584) of Eden's *Arte of Navigation* alongside the textual emendations that mark the image's disappearance in a later edition (1596). I will also argue that the multi-layered and moveable visual images in this text may be the most important element in facilitating the student navigator's progress from student to practising mariner because they occupy a position between mere representation and three dimensional model. By examining the relationship between text and image, between image and reader, we can enhance our understanding of the development of literate practices among a class of artisans more devoted to the life of the hand than to the life of the mind.

Edward B. Davis *Messiah College*

Science and Religion, Chicago Style:
Liberal Protestants and Science in the Age of Bryan

In February 1922, William Jennings Bryan's popular assault on evolution went upscale, when the New York Times published his essay, "God and Evolution." This drew almost immediate responses from biologist Edwin Grant Conklin, paleontologist Henry Fairfield Osborn, and Protestant pastor Harry Emerson Fosdick. Shortly after this, the essays by Conklin and Fosdick were reprinted as the inaugural numbers in what would become a series of nine "Popular Religion Leaflets" on "Science and Religion," published between 1922 and 1931 by the American Institute of Sacred Literature, a correspondence arm of the University of Chicago Divinity School. Shailer Mathews supervised the series and wrote one of the pamphlets himself Fosdick later wrote a second. The other five were written by prominent American scientists: Robert A. Millikan, Kirtley Mather, Edwin Frost, Michael Pupin, and Samuel Christian Schmucker. A tenth pamphlet, co-authored by Mathews, Arthur Holly Compton, and Charles Gilkey, is closely related but not actually part of the series. Although the pamphlets were underwritten by John D. Rockefeller, Jr., and distributed very widely, they are virtually unknown to both historians of science and historians of religion. This paper tells how the pamphlets were found, sketches their history, and analyzes their highly interesting content, placing them in the larger context of the history of Christian thinking about science.

Edward B. Davis *Messiah College*

Teaching Religion and Science

In the past few years, dozens of historians and philosophers of science (including the author of this paper) have developed courses on religion and

science in response to a program sponsored by the John M. Templeton Foundation. Brief comments on this phenomenon are followed by a discussion of syllabi and supporting materials from one such course, focusing on pedagogical issues related to our discipline. The audience will be encouraged to raise questions about the program and about the types of courses it supports.

Alexis De Greiff *Imperial College, London/Observatorio Astronómico Nacional, Colombia*

The North-South Exchange viewed from the Boundary:
Abdus Salam's Conception of the Scientific Internationalism during the
Cold War

Abdus Salam was founder and first director of the International Centre for Theoretical Physics—ICTP—at Trieste, a leading institute for co-operation between Third World physicists and [*his—their*] colleagues in the North during the Cold War. ICTP constituted a meeting point between North and South as well East and West, thus a boundary. ICTP spread a particular view of internationalism and co-operation between North and South. In this paper, I describe Abdus Salam's views of international co-operation in physics and its role in the development of the Third World. His ideology entailed a specific reading of the history of science and a conception of the North-South relations. His experiences as a member of a heterodox Muslim sect, as Pakistani and Professor at Imperial College, as well as his position as director of ICTP shaped that ideology. I analyse the genealogy and the evolution of his internationalists ideas. Finally, a comparison is made between the Salam's arguments, and those developed by natural scientists working the South and close to the “dependency theory.”

Michael S. Dettelbah *Smith College*

Map as Metaphor, Map as Math:
The Meanings of Cartography in the Enlightenment

The use of a geographical model for accounts of the progress of knowledge was commonplace in the Enlightenment, and for that reason we tend to treat it as a metaphor, a conventional figure of speech. Its frequency might instead indicate the importance of controversies over the role of maps and map projections to Enlightenment discussions of the status of physical knowledge. That is, the description of knowledge as a process of creating a true map of the earth might not be metaphorical at all, but quite literal and the subject of much debate. Was the globe an essentially mathematical object, a transcendental structure for organizing physical knowledge? Or did the very arbitrariness of

the map projection, the mathematical graticule, betray the impossibility of any transcendental orientation before or outside of experience? This proposition will be examined with respect to theories of map projection and the survey of Hanover organized by Tobias Mayer and Georg Lichtenberg at Göttingen Georg Forster's Göttingen-based compilations of travel literature his essay on "Cook der Entdecker" and his debate with Kant over the authority of travellers' reports.

David H. DeVorkin *Smithsonian Institution National Air and Space Museum*

Bringing Theory to Mount Wilson in the 1920s

When George Ellery Hale established his Mount Wilson Solar Observatory in 1904, his primary intellectual goal was to build a staff of astrophysicists fully acquainted with the latest developments and methodologies in physics. Over the next decade, as he built the two successively largest telescopes in the world, Hale remained firm in his conviction, but failed time and again to attract strong physics to his isolated Mount Wilson telescopes and laboratories in Pasadena. With the establishment in 1919 of the NRC postdoctoral fellowship program for physics and chemistry, and then in 1924 of the International Education Board (IEB) fellowships, all fuelled by Rockefeller money, a mechanism was in place to attract the best young theorists to Pasadena, where Hale had also transformed a small technical school into the California Institute of Technology and placed it in the hands of Robert A. Millikan. Thus what Hale set into motion for largely astrophysical motives resulted in the creation of a major new center for pure physics, where leading European physical theorists would visit, and send their students, to gain access to the best astrophysical data in the world. Here I discuss the impact upon Mount Wilson and upon theoretical astrophysics resulting from the residencies of European theorists, specifically Svein Rosseland, a student of Bohr, and Albrecht Unsöld, a student of Sommerfeld, in the 1920s.

Nicholas Dew *Cambridge University*

The Menagerie of Versailles and the Visualisation of Nature

The project to rebuild the palace of Versailles got under way in the 1660s, and even before the court had arrived, the gardens were stocked with exotic birds and animals. The menagerie of Versailles presents a striking example of the marriage of 'curiosity' and 'magnificence', or the ways in which the practice of natural investigation in seventeenth-century Europe could profit from the spectacular culture of the princely court. The animals at the menagerie were dissected by members of the *Académie royale des sciences* and thereby became the stars of the sumptuous *Memoires pour servir à*

l'histoire naturelle des animaux (with text by Claude Perrault and engravings by Sebastien Le Clerc). This paper follows the archival traces of the production of this book, from the menagerie to the library. Just as the menagerie itself was a product of the network of collecting agents bringing the animals to Versailles, the book and its images were the outcome of the interaction of several scenes of activity between the court and the printshop. Le Clerc's illustrations, for example, reveal the tension between ideals of observational accuracy and the generic conventions set by other royal publications. The problem of how these images could be made to travel can then be explored through the English translation of the book made by members of the Royal Society. By following such processes in the making of the *Histoire naturelle des animaux*, we can uncover the diverse strategies of display and inscription available to early modern natural historians.

Michael Dietrich *Dartmouth College*

Johannes Holtfreter and the Politics of Gastrulation

As a graduate student with Hans Spemann and later as a young research biologist in the 1920s and 1930s, Johannes Holtfreter contributed to the extremely influential German research tradition concerned with the problem of embryonic induction. Although his relationship with Spemann had never been particularly good, the rise of National Socialism fueled Holtfreter's criticism of Spemann, his work, and his approach. Beginning in the early 1930s, Holtfreter understood Spemann's position on induction, on the organizer, and on gastrulation to be expressions of nationalism and authoritarianism. Holtfreter's voluntary departure from Nazi Germany in 1939 and his subsequent experiences as a refugee scholar solidified his convictions and led him to argue against Spemann's "organismic" approach to experimental embryology. In its place, Holtfreter offered a mechanistic understanding of fundamental embryonic processes such as gastrulation. In Holtfreter's case, the politics of gastrulation motivated his turn to more reductionistic and mechanistic explanations of embryological phenomena.

Matthias Doerries *Max Planck Institute for the History of Science /
Université Louis Pasteur, Strasbourg*

Self-Effacement and Objective Knowledge: Henri-Victor Regnault

For the mid-nineteenth-century French physicist Henri-Victor Regnault, nature—not the experimenter—was the ultimate judge in experimental matters. The experimenter's task was to conceive experimental conditions that would allow nature to reveal its laws directly to the scientist, excluding any analysis

or correction *a posteriori*. This ideal created a paradoxical situation in which the experimenter wished to control every single aspect of experimentation, but at the same time aimed at complete self-effacement, considering himself the ultimate source of all disturbances: nature dictated the course of investigation and enslaved the experimenter. Regnault's ideal was an aseptic experiment, free of human contamination, in which the scientist assumed only the role of catalyst, letting nature perform without interference. Given that contemporaries of the 1840s considered Regnault to be Europe's most outstanding experimentalist, Regnault's relentless pursuit to provide a basis for objective knowledge in experimentation and to make nature speak unambiguously characterise the (short-lived) hopes for absolute certainty of a whole generation of experimentalists.

Sven Dupre *Ghent University*

Galileo, Optics and the Pinelli Circle

Beside Galileo's training in perspective with Ostilio Ricci, early in his career, as shown by Settle, and the scarce evidence offered by the books on optics present in Galileo's library, as shown by Favaro, little is known about the immediate context of Galileo's optics before he began improving the Dutch telescope in 1609. This paper will propose a study of the texts and knowledge of optics circulating in the circle of Gian Vincenzo Pinelli, a patron and avid book and manuscript collector, Galileo became involved with from his early days in Padua during the last decade of the sixteenth century. Among many other things, Pinelli owned the unpublished manuscripts, consisting of lecture notes and drafts of book chapters, on optics of Ettore Ausonio and Giuseppe Moletto, the latter a professor of mathematics at the university of Padua and a student of Maurolico, and the first a mathematician and physician from Venice. That Pinelli took an interest in optics, is shown, on the one hand, by his collection of mathematical instruments, and, on the other, by his own copying of notes of Moletto and his annotations to the "Trattato della Pittura" of Leonardo. However, also Galileo, who would have had access to Pinelli's library, was attracted by the wealth of optical information present in this library, as is shown by his copying of Ausonio's "Theorica speculi concavi sphaerici". By presenting the optics circulating in the Pinelli circle from hitherto unstudied manuscripts, this paper will try to uncover the immediate optical context at the end of the sixteenth century from which Galileo emerged. Finally, this paper will try to establish to what extent the optics circulating in Galileo's information network at this particular moment in his career might have been useful to his own optical work.

William A. Durbin *Washington Theological Union*

Rome's Second Galileo:

Father John Zahm's Abortive Synthesis of Evolution and Faith

The paper highlights the efforts of Rev. John Zahm, C.S.C., priest of the Congregation of the Holy Cross and Notre Dame professor of physics and chemistry, to champion the theory of evolution in Catholic circles in late nineteenth century America. Fr. Zahm's articulate, informed and short-lived crusade to reconcile evolutionary science with Catholic tradition, coming as it did in the anti-liberal, ultramontanist atmosphere of official Catholicism, offers striking parallels to the Galileo case. The pattern of controversy in both "affairs" reveals a persistent, defining issue in the science-religion relation as the claim to the right of interpretation. Zahm, leading a small coterie of like-minded priest-scientists, asserted his authority to reinterpret Catholic theology in light of his interpretation of evolution. His educational agenda, his status as a practicing scientist, his position as priest in a religious order, his flair for popularization, his sense of vocation as a public intellectual, and his allegiance to an Americanist view of the church—together sketch the complex framework of his adjudicating role. Fr. Zahm's quick rise and fall in this role spotlight peculiarly Catholic forms of interpretive authority while suggesting elements common to other Christian traditions. In the end, Zahm's case indicates that neither he nor Galileo were as much martyrs for science, or victims of religion, as ill-fated advocates of a new magisterium.

William Eamon *New Mexico State University*

"Amateur Science" in the Piazza:

The Scientific Underworld of Sixteenth-Century Italy

The early modern scientific community consisted not only of practitioners of the traditional and established scientific disciplines—astronomy, mathematics, optics, medicine, etc.—but of a much larger community of scientific "amateurs," including alchemists, distillers, pharmacists, craftsmen, artists, and virtuosi. My paper will explore this underground community of "amateur scientists" in sixteenth-century Italy by looking at the intellectual circles of the surgeon and natural philosopher Leonardo Fioravanti (1517- c. 1588). From Naples to Venice, Fioravanti engaged with like-minded experimenters who engaged in a great hunt for "secrets of nature." Although he failed in his various attempts to find a princely patron, and was thus excluded from courtly scientific circles, Fioravanti became a part of informal experimental academies in several different cities. In my paper, I shall attempt to reconstruct Fioravanti's various circles and "academies" in Italy and Spain, basing my research on a database of several hundred names of individuals whom Fioravanti mentions in his

writings. This prosopographical approach will shed light on the kinds of persons and practices that constituted the “underworld of science” in sixteenth century Italy.

Mark A. Eddy *The University of Oklahoma*

Educating the Individual:
Competing Visions of the Self and Calls for Education Reform

American social science witnessed unprecedented institutional growth in the decades following the Second World War. This expansion of the social sciences after the war garnered unprecedented public notoriety for individual scientists and brought some into positions of social authority. In the case of prominent scientists like the behaviorist psychologist, B. F. Skinner, and the cultural anthropologist, Margaret Mead, the public role of the ‘scientific social expert’ also allowed for participation in broader political, scientific, and cultural dialogues concerning contemporary issues in American life. In the 1950s and 60s Skinner and Mead each developed broad social theories and engaged in ongoing public debates about the acceleration and expansion of modern life. Rapid change in postwar America had also engendered cultural and scientific revisions of human nature and individuality. While Skinner argued for a mechanistic and reductive approach to human nature, Mead supported a more multidimensional and holistic interpretation. In my forthcoming paper I will examine some of the ways in which these contrasting approaches to the ‘self’ were shaped by the expectations of various public constituencies. Skinner and Mead were particularly outspoken on the importance of education as a vehicle of social reform. Their respective views on education reform brought them public notoriety in part because of the perceived need in the early 1960s for greater military and industrial preparedness in the era of the Cold War. But the dynamic of popularization in each case was also influenced by the common realization that the ever-widening gaps between generations of Americans had rendered traditional techniques of pedagogy, curriculum structure, and administration in American education obsolete. The social experience of each new generation had become increasingly different, and innovative educational methods were needed in order to prepare people for modern life. In addressing the impact on American education of both Skinner’s famous technologies of teaching (i.e., teaching machines and programmed learning) and Mead’s highly publicized critiques of educational methods, I will also explore the public appropriation of scientific representations of the individual and their relationship to contemporary trends in American culture during the 1960s and 70s.

Matthew H. Edney *University of Southern Maine*

Mapping Eighteenth-Century Intersections
of Scientific and Cartographic Practices

Cartographic practices have always featured, sometimes prominently, in general histories of Enlightenment science. They are most obvious in accounts of eighteenth-century attempts to measure the size and shape of the earth and to determine the longitude at sea they provide a persistent context for all reconnaissance expeditions from the metropolitan centers to the European and colonial margins and they served as a conceptual device for organizing and rationalizing observations of spatial phenomena. The relationship between cartography and science can thus be approached in a number of different ways, and at different scales: the individual (e.g., astronomers who happened also to make maps) the institutional (e.g., scientific academies) the social (e.g., the marketplace within which scientific and cartographic texts were disseminated and sold) and, the cultural (e.g., the use of “map” as a metaphor for botanical taxonomy). This paper provides, from the standpoint of cartographic history, a preliminary framework within which to organize these many different elements. Recognizing that there is nothing essential about either “science” or “cartography,” this paper will begin by exploring the principal modes of eighteenth-century cartography (defined in terms of their spatial conceptions, technologies, social institutions, and cultural expectations). From there the task will be to determine the most significant intersections—in practices (e.g., instrumentation) and attitudes (e.g., the “quantifying spirit”)—of mapping activities with those of the sciences. At worst, discussion, with historians of science, of the flaws in this (admittedly ambitious) framework, will stimulate a much needed interdisciplinary exchange. At best, this framework will provide a basis for further explorations in the intermingling practices and ideals of mapping and science.

Joann Eisberg *Independent Scholar/Citrus College*

Making a Science of Observational Cosmology:
The Cautious Optimism of Beatrice Tinsley

Until recent decades, cosmology has seemed to all but its advocates to be a game rather than a science. Many astronomers complained that it was all theory and no data. The problem was that cosmological effects were expected to manifest themselves only at distances too great to be observed. From the 1950s and 1960s, however, a subset of the astronomy and physics communities argued that certain very bright objects—galaxies and quasars—could be seen to such great distances that they might eventually serve as cosmological benchmarks to measure the universe as a whole. Most workers agreed, however, that galaxies and quasars were so poorly understood that any attempt to apply their observation to

cosmology was wildly premature. This paper is about the debate over the maturity of astronomical data and theory, and focuses on why investigators so differed in whether they felt the time was ripe to make a science of observational cosmology. Was it a matter of field and affiliation? Of differing commitments to observation vs. theory? Of differing intellectual taste and style? The paper draws on my research into the life and work of one of the cautious optimists and pioneering theorists in galaxy evolution, Beatrice Tinsley (1941-1981).

Jim Endersby *University of Cambridge*

“From Having No Herbarium”:
Local Knowledge vs. Metropolitan Expertise:
Joseph Hooker’s Australasian Correspondence
with William Colenso and Ronald Gunn

Joseph Hooker’s Pacific floras- of New Zealand (1855) and Tasmania (1860) were partly the product of his own travels and collections in the region, but were largely compiled using the herbarium at Kew. Neither that herbarium nor the floras could have existed without the efforts of collectors based permanently in the colonies. William Colenso was one of the most significant in New Zealand, and Ronald Gunn did similarly invaluable work in Van Diemen’s Land (Tasmania). The correspondence between Hooker, Gunn and Colenso reveals complex relationships, characterised by both deference and friendship, and mediated by exchanges of plants, knowledge, and money. A central theme is a polite but often fierce competition over the value of their respective knowledge—the global, generalising erudition of the metropolitan expert, and the local, particular expertise of the colonial collector. Sometimes sharp differences over plant taxonomy and distribution emerge from these competing interests. For example, Hooker argued that Kew’s herbarium and library gave him the sole authority to name species and determine their geographical and morphological limits, and while Gunn and Colenso largely accepted his authority, they occasionally tried to assert that their more detailed knowledge of living plants gave them unique insights into such questions. A close reading of the letters, together with an examination of Victorian botanical collecting practices, reveals a complex negotiation over the status of particular knowledge.

Nathan L. Ensmenger *University of Pennsylvania*

Chess Players, Music Lovers, and Mathematicians:
Towards a Psychological Profile of the Ideal Computer Scientist

In the early 1950s, the academic discipline that we know today as computer science existed only as a loose association of institutions, individuals, and

techniques. Although computers were widely used in this period as instruments of scientific production, their status as legitimate objects of scientific scrutiny had not yet been established. Computer programming in particular was considered by many to be a “black art, a private arcane matter, general programming principles were largely nonexistent, and the success of a program depended primarily on the programmer’s private techniques and inventions.” Those scientists who left “respectable” disciplines for the uncharted waters of computer science faced ridicule, self-doubt, and professional uncertainty. As the commercial computer industry expanded at the end of the decade, however, corporate interest in the science of computing increased significantly. Faced with a serious shortage of experienced, capable software developers, corporate employers turned to the universities as a source of qualified programmers. Academic researchers, unsure of what skills and knowledge were associated with computing expertise, began to develop a detailed psychological profile of the “ideal” computer scientist. Their profile included not only an aptitude for chess, music, and mathematics, but also specific personality characteristics (“uninterested in people,” “highly detail oriented,” etc.). Many of these early empirical studies turned out to be of questionable validity and were of almost no use to potential employers nevertheless, many of the characteristics identified in these early personality profiles survived in the cultural lore of the industry and are still believed to be indicators of computer science ability. My paper explores the development of computer science as an academic discipline from the perspective of the corporate employers who encouraged it as a means of producing capable programming personnel. I explore the uneasy symbiotic relationship that existed between academic researchers and their more industrial-oriented colleagues. I focus on the use of psychological profiles and aptitudes as a means of identifying “scientific” abilities and expertise.

Fa-ti Fan *Max Planck Institute for the History of Science*

Nature and National Narratives in Early Twentieth-Century China

One of the most powerful discourses of nationalism is the argument that the components of a nation are “naturally” bound together. For the nation idealized in this discourse, its people, land, and sovereignty constitute an organic whole whose history is an analogy, or even an extenuation, of natural history. This paper examines an influential strand of Chinese nationalism in the first decade of the twentieth century when the influx of Western science—including natural history, Darwin’s theory of evolution, and racial science challenged traditional Chinese knowledge of “nature.” Chinese intellectuals constantly had to revise their conceptual framework and invent new language to accommodate Western learning. This paper analyzes how the historical actors defined and redefined history, tradition, and nationhood in relation to the transmutations of the concept of nature.

Marianne P. Fedunki *Stevens Institute for History and Philosophy of Science and Technology*

Malaria and 20th Century Medicine: Fighting Disease with Film, 1940-2000

This paper examines the role of film in educating scientists, clinicians, and the general public about the transmission of malaria from 1940 to the present. The films were produced as both public health propaganda and as scientific/clinical training films directed at a specialized audience. They include both basic and applied science as well as material for general Western and indigenous audiences. I will set these films within their colonial and later post-colonial frames of discourse and also evaluate the films' impact on their target audiences, plus the role of foundation sponsorship in producing and distributing them. Archival sources for this study include: The Wellcome Trust (London), Imperial War Museum, Shell Centre (London), British Film Institute, World Health Organization, and Liverpool School of Tropical Medicine. This paper is part of a larger study of how film served as a way to disseminate "colonialist science," particularly in East Africa. There is a large body of anti-malaria films, including even a contribution by Walt Disney Productions, "The Winged Scourge" (1943)

Mordechai Feingold *Virginia Tech*

Scientists and Amateurs in Seventeenth-Century England

In her *Scientists and Amateurs: A History of the Royal Society* (1949), Dorothy Stimson differentiated the few "true" scientists from a much larger group of practitioners who satisfied "their curiosity rather than attempting to pursue scientific learning." For the latter, she argued, science was "a recreation in which they delighted, not an activity to which they devoted their whole time and thought", though they served an important role as "a welcoming audience for the new discoveries" and as patrons to scientists. The passage of time has done little to dispel such an image and my paper intends to probe the nature of the scientific community during the seventeenth century in an effort to demonstrate that "amateurism" was a function of social or professional standing, not an indication of competence.

Maurice A. Finocchiaro *University of Nevada—Las Vegas*

Giordano Bruno, 1600-2000

Giordano Bruno was burned at the stake in Rome in the year 1600, and this year (2000) several organizations are commemorating the four-hundredth anniversary

of his death. This paper aims to make a small contribution to this anniversary from the vantage point of a Galileo scholar. That is, I would like to make a critical comparison and contrast between the respective trials of these two thinkers: I plan to focus on the causes for their condemnations by the Inquisition; the procedures followed during the proceedings; and the aftermath in modern Western culture. My expectation is that to compare and contrast the two trials together will provide a better understanding of both the Galileo affair and the Bruno affair. Some of the questions and working hypotheses to be explored and tested are: that just as in the Galileo affair one must resist the temptation to act as if the only issues were astronomical and scientific (and thus neglect the methodological, philosophical, and theological issues), so in the Bruno case one must resist the temptation of claiming the only issues were metaphysical and theological (and none astronomical); that although the cause for which Galileo was fighting was not worth dying for, Bruno's cause was, and indeed it required his ultimate sacrifice (as some authors have suggested, e.g., Ernest Renan, Albert Camus, and Hans Blumenberg); and what is the significance of the fact that the documentation of the two trials is similar only with respect to a single document, namely the "executive" summaries of the respective proceedings on the basis of which a final sentence was arrived at?

Gerard J. Fitzgerald *Carnegie Mellon*

"Mechanization through Standardization,"

Bacteriological Engineers and Biological Weapons at LOBUND, 1928-1955

This paper examines the scientific and technological development of the isolator system designed and constructed by Professor James A. Reyniers of the Laboratory of Bacteriology at the University of Notre Dame (LOBUND) from 1928-1955. Originally designed in 1928 as an instrumental system to facilitate "germ-free" and pure culture work in bacteriology, the isolation machinery provided an experimental space free from possible external contamination. The system also provided biological and medical researchers with an equally effective space for bacterial containment. During World War II, and continuing throughout the Cold War, United States scientists utilized this system as an experimental bacterial and viral containment system for biological weapons research. Isolation units were employed in Reynier's group at the University of Notre Dame for the freeze-drying of typhus and by Karl Meyer research on plague sponsored by the United States Navy at the University of California at Berkeley. In addition, Theodore Rosebury who headed the Airborne Pathogen Laboratory at Camp Detrick, converted isolators into experimental cloud chambers to test *Serratia Marcescens*, *Bacillus Globigii*, *Brucella Suis*, *Malleomyces Mallei*, and *Pasteurella Tularensis* as possible air-borne biological weapons. Research conducted at Camp Detrick was especially important in early post war decision making on future biological weapons research projects.

Much like the atomic bomb, the creation of this new class of weapons depended upon the invention and integration of new and existing technological and scientific instruments, machines, techniques, and methodologies. The research of Professor Reyniers provides the historian of science with an analysis of the instrumental applications to biological weapons research. In addition, an analysis of the work carried out by Reyniers and his laboratory allows one to probe the larger scientific and institutional forces that drove the United States biological weapons research program.

Maura C. Flannery *St. John's University*

The Lab Coat: Symbol of Science as a Male Pursuit

In a commentary on feminist critiques of science, Ruth Bleier writes that the lab coat gives the scientist “a faceless authority that his audience can’t challenge . . . a powerful, mysterious, impenetrable, coercive, anonymous male voice.” Thus the lab coat can be seen not only as a symbol of science, but of masculine science at the very least, it disguises the gender of its wearer. In this paper, I will examine the rise of the lab coat as a symbol of science, using paintings, prints, and photographs to document this development. I will also explore the difficulties which clothing posed for women wishing to participate in scientific inquiry, particularly in field biology, in the 19th century. As women became more involved in science, they became more involved with its trappings, signified by the number of female as well as male scientists photographed in lab coats. Women no longer have the problems of dress that plagued 19th-century women interested in science. But in putting on the white lab coat, they put on more than a protective covering against the grime and caustic chemicals of the lab they also put on clothing which supposedly symbolizes a superior way of thinking, a better way of looking at the world. Thus examining the dress of female and male scientists involves looking at more than the surface it entails examining the power of a symbol to influence people’s attitudes toward science and scientists. While the lab coat is now often seen as passe, with many scientists eschewing its use, it is still very much a part of the iconography of science, and is still often used to represent science in nonscientific contexts.

Kevin J. Francis *University of Minnesota*

Popularization and the Role of Humans in late Pleistocene Extinctions, 1927-1957

Following the most recent glacial period, more than thirty genera of mammals disappeared from North America. The 1927 discovery of numerous stone points

intermingled with extinct bison bones at Folsom, New Mexico, provided evidence that humans had once coexisted with these extinct mammals. Today many scientists interpret such “mass kill sites” as evidence for a human role in these extinctions. However, few scientists considered this possibility until the 1960s. Instead, they theorized that postglacial climate changes were responsible. Nineteenth-century European scientists, in contrast, were quick to link humans to late Pleistocene extinctions. In the late 1850s, similar discoveries convinced most scientists that humans and extinct animals had once coexisted. Almost immediately, many prominent English and French scientists argued that humans had contributed to these extinctions. In this paper, I argue that twentieth-century paleontologists and paleoecologists were reluctant to consider a human role in late Pleistocene extinctions because humans fell outside their traditional concerns and explanatory mechanisms. In other words, they assumed that natural scientists studied nature rather than humans. And because archaeologists and anthropologists rarely addressed changes in nature as sweeping as mass extinctions, the question of a human role remained in mostly unexplored terrain between the natural and human sciences. Three American scientists (Edwin Colbert, Loren Eiseley, and Carl Sauer) publicly discussed this question at length between 1927 and 1957. By examining the popular and technical works of these scientists, I argue that the process of preparing exhibits and writing works for general audiences encouraged communication between the natural and human sciences on the question of a human role in these extinctions. I show that popularization by scientists, which is often dismissed as a harmless but inconsequential diversion, can promote interdisciplinary collaboration and shape scientific knowledge.

Eckhardt Fuchs *Max Planck Institute for the History of Science*

The Mechanics of Transnational Science:

The Escuela Internacional de Arqueología y Etnología Americanas (EIAEA)
and the Scientific Exploration of pre-Columbian Mexico

As a result of longstanding efforts by the German-American anthropologist Franz Boas, in 1911 the International School for American Archaeology and Ethnology was founded in Mexico City as an international research institution. Three US American universities and one scientific society, the German, French, and Mexican governments, and later several European institutions participated in the work of the EIAEA. In tracing the short history of this institute (1905-1920), the paper investigates the mechanics of transnational scientific cooperation. It was founded at a time when European and American scholars started to explore the pre-Columbian history of Mexico and when Mexico became a political battlefield of the imperialist rivalry between the USA and Europe. In the paper I will show that the initiative for the establishment of the EIAEA was based on the idea of uniting and centralizing the research on pre-

Columbian history previously done by several countries and institutions. Although the Mexican government belonged to the undersigned of the statute of the EIAEA, this enterprise faced some opposition from Mexican anthropologists and archaeologists who feared scientific imperialism by their American and European colleagues. Whereas this controversy over the protection of Mexican antiquities and the scientific status of their own disciplines was mostly confined to the Mexicans, the changing international context—with the outbreak of the Mexican Revolution and the European Great War—greatly effected the scientific cooperation. Nationalist resentments led to changing and unstable alliances between the scientists depending on the foreign politics of their countries. The lack of governmental cooperation in funding and supporting the institute on the one hand, together with the intention of Mexican scientists to take over the scientific exploration of their own country as a national task led finally to the collapse of the EIAEA.

Mary O. Furner *University of California, Santa Barbara*

The Enlightenment Ideal, the Social Sciences, and Governance, 1880s-1940s

As the current vogue of the Enlightenment so forcefully reminds us, the modern “sciences of man and society” arose as part of a revolutionary epistemology that shifted the grounds of authority in policy making from “dead” tradition to active reason. In relation to feudal/monarchical states of the premodern past, the modal Enlightenment form of governance was, in fact if not in form, a republic, as Voltaire judged England to be, despite its monarchy, in light of the freedom of discourse there. Yet, within this Enlightenment frame of reference, the total and rapidly growing stock of social knowledge was taken as in some sense the possession and “voice” of civil society, to be intoned critically, in judgment of the actions of “rule” by a sovereignty of any type, even a virtuous republic. If the proper institutional settings for the rational, critical deliberations that judged the actions of states were voluntary associations of citizens in civil society, how would this expectation be altered when states, seeking improvement, competitive advantage, and a wider legitimacy, became increasingly dependent upon social knowledge and social science? How would the Enlightenment tradition of critical distance from power be maintained when states, and public officials in the rising numbers of statistical agencies, were increasingly the actual producers of social knowledge, and when governments drew upon and subsidized the development of social science expertise? How would expectations about this state/social knowledge relationship shift within the various social sciences, as various strands of professionalization and academicization proceeded from the late nineteenth century forward? Did a gendered access to work in social science (exclusively male in the universities a female preponderance in the social settlements and social welfare) produce

a gendered conception of the state/social science relationship that approximated gendered legal conceptions of individual rights, or has this difference been unduly exaggerated, masking other, more important lines of difference in this regard? Can we argue that a “bureaucratic ideal,” developed (quite different from what Weber expected) within the liberal social sciences from the 1880s through 1940s, that this ideal bridged or transcended concerns about maintaining boundaries between knowledge and reform to create a distinctively American vision of planning, linking the social sciences (especially economics and public administration), public social investigation, and the state? Then how did changes in the meaning(s) of planning undermine this vision, both in the post-World War II reversion to technocratic management, first widely posited in the 1920s, and in the post-1970s ideological wars? Why, in the current, post-liberal, post-modern climate, is there so much nostalgia for an Enlightenment vision of reasoned deliberation based on good theory, and yet so little success in imagining how our highly quantitative, model-oriented social sciences could serve as “that noble science of politics?” I hope to explore conceptions of the relations of social science and governance, as they have changed over time, mainly in the New Liberal era, 1880s through 1940s, but with some comments about implications for the location and role of the social sciences in more recent period of heightened relativism, identity politics and “hyper-democracy.” I will also offer some comments on the papers of Professors Porter and Ross.

Aileen Fyfe *University of Cambridge*

Industrialised Conversion:
Publishing Popular Science and Religion in Victorian Britain

In the middle decades of the nineteenth century, questions of scientific expertise and authority were highly controversial. During this time, changes in the publishing trade created a new genre of cheap popular science books, whose publishers had to address such issues in deciding who to ask to write the books, and what style should be used. They also had to balance the commercial pressure to sell books, with their own religious or philanthropic ambitions about whom they should sell books to, and for what purpose. The publishers I examine in this paper focused their activities around their desire to convert their readers to evangelical Christianity, in part by relating science to revealed theology. I consider their methods of reaching their audience, from the material processes of printing and distributing, to the textual strategies that came into play once the book found a reader. In so doing, I argue that studies like this provide an alternative perspective in a field which has remained dominated by nineteenth-century narratives of secularisation and professionalisation.

George D. Gale *University of Missouri, Kansas City*

Comprehending the Catastrophe:

The Role of Medical Models in the Phylloxera Grapevine Plague, France,
1868-1875

Plants get sick, too. Sometimes this banal truism masks events of incredible significance. When the sick plants have economic importance to human beings, consequences of truly global scope may be entrained. The Irish potato blight of 1848 is a prime example of this fact. Other plant disease epidemics—epiphytotic—also plagued the Nineteenth Century. Since plant pathology at this time was sorely underdeveloped theoretically, the central question in each of these disasters was: How are these plant diseases to be understood? The present study, which focuses upon the scientific response to the devastating Nineteenth-Century grapevine plague known as the phylloxera crisis, attempts to answer this question in one important historical case. Bluntly stated, my two conclusions are these: 1. Understanding the grapevine phylloxera epiphytotic depended crucially upon then-extant medical models of human disease; and 2. Since there were two competing disease models prevalent at the time, a controversy regarding the etiology and nature of the malady inevitably arose. My argument is organized as follows. First, I describe the onset of the malady in some detail, and chronicle the first few years of its march across the vineyards of France. Secondly, in the following two sections, I provide a brief description of the Nineteenth Century versions, first, of two general models of human disease and, secondly, of plant pathology. In the penultimate section, I focus tightly upon the details of the first several years of controversy between leading proponents of the two sides in the dispute over the origin and nature of the malady. This discussion will situate the arguments of the two sides under the aegis of their respective human disease models. Finally, in a brief concluding note I will give an admittedly Whiggish summary of the outcome of the crisis, and relate it to a similar epiphytotic disaster unfolding in the vineyards of today's California.

Janet Garber *Independent Scholar*

Jane Franklin and the Natural History Museum Idea in Tasmania

In 1828, Jane Griffin, who had led a life of parties, balls, operas, museums, and tours of the Continent, married the Arctic explorer, Sir John Franklin. In 1836, Franklin became Governor of Van Diemen's Land. He and Jane arrived in 1837, and two years later founded a scientific society, where papers were presented by visitors John Gould and Joseph Hooker, among others. In 1837, Jane bought 130 acres for a botanical garden. Exhibits were arranged in Government House, pending construction of a museum. Jane then purchased 400 additional acres of

land adjacent to the botanic garden, and erected a small museum of natural history. The foundation stone was laid in 1842. But the Franklins left Tasmania in 1843, and by 1853 the museum fell into disrepair, its library and collections dispersed, and the building became a storehouse for apples. Yet, for a short time, Tasmania was the first country outside of the United Kingdom to boast a Royal Society for the Advancement of Science, with a museum.

Margaret D. Garber *University of California, San Diego*

Legislating Light in Post-Rudolfine Prague:
The Role of Light in the Alchymical Philosophies
of Marcus Marci von Kronland

According to the Imperial Physician Marcus Marci von Kronland (1595-1667), citizens of Prague who fell ill in the 1660s faced twin dangers: either they chanced Galenic physicians who purged them with poisons, or fell victim to alchymical charlatans who purged their pockets with gusto. To remedy these social maladies, Marci prescribed a true and useful alchymy, apparently revived through ancient theoretical foundations. However in assigning legitimacy to his own chymical arts, Marci sought support closer to home; he transmuted his arts into a rendering compatible with the locally plausible and longstanding Habsburg interests in astrology. By grounding his cosmology in the astrological/astronomical theories of Rudolfine court luminaries Johannes Kepler and Tycho Brahe, Marci recast the role of light as the bearer of both planetary influences and seminal forces. Moreover, he wove the works of these Habsburg notables, with whom he was gainfully affiliated, into a thickly plaited lineage that unraveled in some ancient, pre-Egyptian past. Marci's *Philosophia Vetus Restituta* (Ancient Philosophy Restored) attempted to systematize nature's alchymical agency. He ambitiously proposed semina-carrying light as the explanatory mechanism for growth and transformation in metals, plants, animals and humans, and one that initiated and provoked rays carrying astrological influxes. Marci's strategies of legitimating alchymical magic suggest that he played the achievements of court astronomers, with whom he was aligned rather loosely, against the skepticism of University scholars, with whom he was employed. Simultaneously, Marci's text invites the reception of Keplerian astronomy into the dynamics of alchemical philosophies.

Sander J. Gliboff *Johns Hopkins University*

The Case of Paul Kammerer

From 1904 through 1926, reports of remarkable morphological transformations of frogs, toads, salamanders, and other animals issued from Paul Kammerer's

laboratory at the Biologische Versuchsanstalt [Institute for Experimental Biology] in Vienna. In his prolific technical and popular writings and especially in the “big show-lectures” he gave all over Europe and the U. S., Kammerer argued that his careful manipulation of the animals, environment had caused them to change, and that the changes were hereditary. Further, he claimed that his insights into the evolutionary process could be put to use to ensure human progress, both physical and cultural. Kammerer’s conclusions were irreconcilable with what later became a central tenet of Darwinian evolutionism: the non-inheritance of acquired characteristics. As a result, he has come to be seen as an opponent of Darwinism. His suicide in 1926, amid suspicion that he had faked one of his transformed specimens—the infamous midwife toad—has made it easy for modern Darwinians to dismiss him as a crank and a fraud. This paper therefore re-tells Kammerer’s story with special attention to three aspects of his context: the intellectual faction within the Darwinian fold, with which he identified himself the material and institutional culture of his laboratory and his popularizing mission and presentation techniques. It shows Kammerer’s battles to have been not against Darwinism, but for the inheritance of acquired characteristics within Darwinism, for the use of experimental methods in support of Darwinism, and for the popularization of a Darwinian world-view in the spirit of Ernst Haeckel. Finally, it offers a new explanation of the midwife-toad scandal and what it reveals about Kammerer’s methods and the credibility of his work.

Anne Godlewska *Queen’s University—Kingston*

When is Description Mere Description? The Nature of 18th Century
Geography

In a recent book focused on the transition period from Enlightenment science to modern empirical science I described geography’s difficulties in reformulating itself as an intellectually respectable modern science. My preferred way of describing the transition the field was undergoing has been as a movement away from description and towards theory-based explanation. I initially chose the word ‘description’ because it was the word French geographers used in the title of their monumental *Description de l’Egypte* and which, incidentally, was not used in a similar work on Algeria thirty or so years later. It also seemed an excellent characterization of the kind of geography practiced by map makers and universal geography writers of the 18th century. In fact, those early nineteenth century geographers who saw themselves as working in a defined tradition of research also engaged in work that tied to a descriptive approach: mapping, universal geography writing; and data collection for the exercise of state power. On the margins of the group of people who described themselves as geographers were a few individuals who in the first half of the 19th century were beginning to problematize description and to structure their work around the explanation of social phenomena, the explanation of natural phenomena and the developing critical approaches to

the study and analysis of past societies. What I would like to explore in this paper is what Enlightenment Geographers meant when they used the word ‘description’ and, perhaps more importantly, exactly what I mean when I use the word. In so doing, I will explore how philosophers of science have used the concepts of description and analysis.

Jordan Goodman *University of Manchester Institute of Science and Technology*

Mr. Huxley’s Voyage?

Making Imperial Space and Knowledge in the mid-19th Century

This paper focuses on the voyage of HMS *Rattlesnake* (1846 to 1850) as an example of scientific practice, its products and its representations in nineteenth-century voyages. The ship was engaged by the Admiralty in surveying the east coast of Australia and the south coast of New Guinea to ensure safe sailing for steam shipping between Australia and India. On its survey, the ship collected a substantial amount of physical data—terrestrial magnetism, weather and ocean soundings—and produced a number of charts and sailing instructions for the Admiralty. In common with other naval surveying vessels of the period, the ship carried several naturalists, including John MacGillivray, John Thomson and James Wilcox, in addition to Thomas Huxley, who practised their science and collected officially for public institutions and privately for commercial contacts. Natural history extended to ethnology and linguistics, both of which figured largely in the voyage’s collecting activities. All of the naturalists, many of the ship’s officers, and the commander kept journals and sketchbooks. Because of the existence of this material it is possible to go far beyond the published accounts and to get very close to the experiences of many on board. Historians have almost totally neglected (with a few notable exceptions), the sea and the ship as sites of scientific practice, especially in the nineteenth century. This paper will redress this balance and aims to place the sea and the ship at a crucial juncture of nineteenth-century science and empire-building. It will explore the nature of science on the move the integrative role of voyaging in scientific practice, including surveying and the key role of perspective in representing the practices and products of the voyage, in order to make better sense of what it meant to carve out an imperial space at the same time as doing science in this crucial period.

Michael D. Gordin *Harvard University*

A Hierarchy of Sorts: D. I. Mendeleev and the Periodic Table

The periodic table’s formulation by D. I. Mendeleev (1834-1907) in 1869 is often seen as one of the capstone theory constructions of the physical sciences in the

nineteenth century. Few historians, however, have explored the intellectual origins of the table that is, to the set of resources upon which Mendeleev had to draw in order to construct the theory. These sources are chiefly two, both of which not usually seen as contributing to the periodic table: Gerhardt's organic type theory and concerns about hyper-light elements, including the chemical ether. This paper situates the intellectual construction of the periodic table in between these two disconnected (and discarded) traditions of chemical reasoning. Initiated by the Karlsruhe chemical congress of 1860, Mendeleev's speculations about the nature of atomic weight and the different types of organic and inorganic chemical organization were refined during his construction of a series of chemical textbooks: *Organic Chemistry* (1861, 1863), and the famous *Principles of Chemistry* (first edition, 1869-1871). Only by fusing the pedagogical functions of these textbooks with the twin intellectual origins can one come to an understanding of how this theory of classification emerged in post-Emancipation St. Petersburg.

Michael John Gorman *Dibner Institute for the History of Science and Technology*

A Microcosm of Mathematical Knowledge:
Johannes Kepler and the Death of Painting

A new pictorial genre emerged in early seventeenth-century Antwerp—the gallery painting. Painted representations of *Kunstkammern*, executed in meticulous detail, depicting overflowing collections of artificialia and naturalia were themselves transformed into the objects of cultivated curiosity and displayed prominently to visitors to the collections that they depicted. Commonly painted on portable copper-plates, these representations could also permit virtual viewing of a gallery, when sent to distant friends and relations. The minute detail in which these paintings were executed encouraged the use of magnifying lenses in their examination, further reinforcing the analogy between the pictorial representation of the gallery and the curiosities contained within its walls. In addition to their representational function of providing a faithful depiction of a particular collection, such works commonly had an extremely strong allegorical function. They encoded a model of the virtuous patron by situating him or her in relation to an idealised ordering of nature and artifice. They also encoded models of natural investigation, frequently depicting the debates between natural philosophers, the use of astronomical instruments and maps. Artists such as Jan Brueghel I, Frans Francken II, Rubens and Willem van Haecht used this genre to deliver increasingly complex messages about the relationship between the natural world and the various available techniques available for its representation. This paper will analyse one such painting in detail, comparing it with other examples of the genre. I identify the subject of the painting as Johannes Kepler, and explore the relationship between graphical representation and instrumentally produced astronomical knowledge that it describes.

Marianne Gosztonyi Ainley *University of Northern British Columbia*

Gendered Careers? Canadian Women in Science, 1890-1970

During the 1890-1970 period, numerous women scientists were employed in Canada but remained in low-level positions for longer than did their male peers. Most women scientists performed “women’s work”—poorly paid and under-valued jobs men did not want, and were not expected, to do. In fact, even the seemingly successful women scientists, such as the geneticist Carrie Derick (1862-1941), the chemist Clara Benson (1875-1964), the economist Mabel Timlin (1891-1976), the astronomer Helen Hogg (1905-1993), and the physicist Barbara Judek (b.1923) faced difficulties because of their gender. In this paper I will draw upon my research in the history of Canadian science to provide the context within which to discuss the experiences of women scientists who worked at various universities and government institutions.

Brian Greene *University of California, Los Angeles*

Making the Invisible Visible:

The Public Health Efforts of Dr. W. W. Peter and Dr. Tee Han Kee
in Early 20th Century China and The Philippines

This paper will examine the public health efforts of two figures during the early twentieth century. W. W. Peter, who received his Ph.D. in Public Health from Yale University, spent nearly twenty years (1911-1929) in China promoting public health through the use of visual tropes in public lectures. Dr. Tee Han Kee received his L.M.S. degree from Hong Kong Medical College in 1902. He then went to Manila, Philippines, where he promoted public health among the *huaqiao* (overseas Chinese) community up through the 1930s. The common link between these two figures is a learned and similar modern medical knowledge that they both utilized in their efforts to control diseases, such as cholera, among Chinese populations. In the case of Dr. Peter, his work in China reflects larger trends in early 20th century American science and American expansionist politics. Peter’s public health work also illuminates the problematic details of deploying knowledge and practice in an area having its own cultural norms and behavior. In the case of Dr. Tee, we have the opportunity to see another facet of the transmission of medical knowledge in a Chinese context. Tee is among the first generation of Chinese who study western medicine in China. However, in an interesting twist of circumstances, Tee then carries this medical knowledge beyond the geographic boundaries of China and deploys it among the Chinese population of Manila. Chinese history has traditionally operated in the mode followed by many historical studies, that of the national history. With this, most histories of China, including those written in China, have focused on events that unfolded within what is defined spatially as China. Recently, studies of *huaqiao* have appeared in cultural studies literature,

which challenge aspects of the national history. Moreover, an article focusing on huaqiao recently appeared in the *Journal of Asian Studies* that will surely attract the attention of China historians with its broad readership. As historical exposition begins to move beyond the mode of national histories, the China field will have to contend with aspects of Chinese history that unfold in spaces not traditionally considered China and have thus been ignored. Dr. Tee's scientific practice dovetails nicely into this growing area of Chinese history. The work of both Peter and Tee reflects specific mechanisms by which western scientific knowledge was transmitted and institutionalized in modern China and how this knowledge displaced, coexisted and competed with pre-existing Chinese forms of scientific knowledge and practice.

Frederick Gregory *University of Florida*

Continental Critiques of Scientific Objectivity

During the last decades of the nineteenth century representatives of different sectors of the German and Austrian intellectual community contributed to fundamental questioning of the popular image of the objectivity of scientific knowledge. While the contributions of the physicist Ernst Mach, the theologian Wilhelm Herrmann, and the philosopher Hans Vaihinger represent just three articulations of this concern, this paper investigates the individual agendas that motivated each one and inquires to what extent the common thread of their arguments caught on in the years around the turn of the twentieth century. Implicit in this inquiry is another: can these critiques of the objectivity of science suggest ways in which we can understand the obvious appeal scientific objectivity held for many and the function it performed for them?

Daniel Haag *Institute of Soil Science and Land Evaluation, University of Hohenheim*

Ecosystem Simulation: Dynamical Systems vs. Self-Modifying, Historical Systems

Dynamical systems are the paradigm for the formal representation of complex natural systems in simulation modeling. Based on the notion of an abstract state, ecosystems are encoded in a closed set of equations with determined parameters. For the encoding, the system is severed from its environment and from background "noise" discriminating supposedly essential from accidental features. Parameters in dynamical systems are fixed a priori, many of them being parameters of convenience which fulfil the formal needs of (systems) theory. To account for ecosystem "complexity", the number of parameters often is increased unrestrictedly. The ensuing non-identifiability of parameters is a major shortcoming

of simulation models. Such dynamical systems are conceptually closed and computable systems. In contrast, natural ecosystems are open, self-modifying systems. The self-modification of ecosystems leads to the continuous (on-line) production of internal novelty and thus of new parameters. Ecosystems are characterized by a history of system-environment interactions, in which order may emerge from “noise”. Thus there are no grounds on which noise and (eco-)system could be distinguished. Historicity and self-modification of ecosystems make non-trivial predictions of future outcomes impossible. Concurrently, the closed simulation models containing numerous parameters of convenience lose reference to empirical reality and become mere “fitting machines”, which can be adapted to any data set. Notwithstanding, the modeling process, as a learning and communication process, can be a mode of coping with different types of complexity.

Caroline C. Hannaway *National Institutes of Health*

NIH Scientists and International Understanding of the Spread of HIV

National Institutes of Health scientists initially perceived AIDS primarily as a syndrome affecting gay men in the United States. But with the expansion of groups at risk in American to include recent Haitian immigrants in 1982 and the response in Haiti that this identification provoked, the NIH became drawn into international investigation of the spread of HIV. A short-term NIH investigation in Haiti was followed by a much larger and more influential project to examine the spread of HIV in Zaire and to understand the epidemiological and clinical differences of AIDS in different countries. This Zaire project was carried out in cooperation with the Centers for Disease Control and the Prince Leopold Institute of Tropical Medicine in Belgium. This paper will explore how NIH scientists began to perceive the international dimensions of the AIDS epidemic and the initiatives that were taken to investigate the implications of the global spread of the disease. As is often characteristic of NIH research, international AIDS research at the NIH began with personal initiative rather than a government mandated investigation. But the nature of Project SIDA in Zaire was framed in part by Public Health Service directives. The paper will contribute to the examination of the complexities of undertaking AIDS research in the federal government and enlarge understanding of the interaction of federal agencies on public health problems.

LeeAnn Hansen *California State University Fullerton*

Constructing a Public Psychology:

Karl Philipp Moritz and the *Magazin zur Erfahrungsseelenkunde*

In The Structural Transformation of the Public Sphere Jürgen Habermas notes

in the later 18th century the growing recognition of subjectivity, of the interior private space of the individual mind or soul, as the inverse side of the objective public sphere. The relation of self and other, of subject and object, he says, became problematic at this time. Subjectivity itself emerged as the inverse side of the public sphere with the appearance of psychological novels such as *Pamela* and *Werther*. It also emerged in the appearance of a new public psychology, distinct from the philosophy of mind long familiar through figures such as Locke, Hartley, Leibniz, Wolff, etc. I focus on Karl Philipp Moritz (1756-93). In his journal, the *Magazin zur Erfahrungsseelenkunde*, Moritz proposed such a discipline, founded on the public sharing of information. He invited members of the literate public such as doctors, pastors, teachers, prosecutors, etc., to share their knowledge of specific cases of aberrant behavior, providing the empirical evidence needed to construct a new science. Traditional analysis of the properties of mind formed only one strand of this tapestry. Contemporary medical thought, particularly the work of Moritz's friend, Marcus Herz, was another. It was to be a collaboration by the entire literate public, including writers (like Moritz himself) who could add their insights into human personality and motivation. There was another aspect to the project: the observer of human psychology must also observe himself. Moritz was aware of the paradox here: the self as knowing subject is also the self as an object to be known. In an attempt to establish an empirical psychology and delimit the boundaries between subjective and objective experience Moritz and his contributors offered their own psyches, their nightmares, hallucinations and depressions, for public scrutiny. Undertaken in the spirit of Enlightenment, the enterprise in fact problematized the relationship between subject and object and helped to construct the issues which would obsess Romantic writers and the *Naturphilosophen*.

Elizabeth Hanson *The Rockefeller University*

Women Scientists at the Rockefeller Institute: A Collective Biography

The Rockefeller Institute for Medical Research was founded in New York City in 1901 through the philanthropy of John D. Rockefeller. Modeled on the Koch and Pasteur Institutes, it was the first research center in the United States devoted exclusively to studying the underlying causes of disease through scientific research. Between 1901 and 1946, more than 50 women held research positions at the Institute in areas including bacteriology, experimental surgery, chemistry, and biophysics. This paper makes use of archival sources and other biographical sources to assemble a prosopography of this group. Historian Lawrence Stone has defined prosopography as "the investigation of the common background characteristics of a group of actors in history by means of a collective study of their lives." The technique has been used to understand the behavior of scientific communities such as the Royal Society of London

and 19th century British naturalists. The population examined here is relatively small. My aim in studying this group is twofold. First, to understand factors that empowered or inhibited women's participation in research at the Institute by looking at the educational backgrounds of women scientists, the circumstances that brought them to the Institute, and how their careers developed at Rockefeller and later. Second, to bring to light individuals or groups whose careers deserve more detailed inquiry through traditional biographical methods.

David N. Harley *University of Notre Dame*

“The Scientific Revolution”: Boxing for England?

The concept of “the Scientific Revolution” has been criticized from a variety of viewpoints, for distorting our understanding of the history of natural inquiries. It has been observed that it remains useful for didactic purposes, although the items that are now placed into this empty box are quite different from the ones formerly thought crucial. There remains, however, one characteristic of the box that seems so natural that it is virtually unobserved, its intrinsic Englishness. The narratives that relate to this category always seem to end in the England of the early Royal Society, whether they start with Copernicus, Vesalius and Paracelsus or with Galileo and Mersenne. There are several related reasons for this phenomenon. The concept is mainly deployed by English-speaking historians. The concept was developed in post-war Cambridge. The concept was designed as a weapon for post-war reconstruction and the Cold War, showing that the modern world sprang from the England of the Restoration and the Glorious Revolution, not the French Enlightenment, which had led to totalitarianism. The concept was not challenged by socialist historians, who wanted to show that the modern world sprang from the English revolution of 1649 and accordingly emphasized economic developments, artisans and politico-religious radicalism, with only a slight modification in terms of location and chronology. However we rewrite our narratives to include additional features, the very shape of the box will tend to lead us to the world of Locke and Sydenham, Boyle and Newton, because that is the way it is designed, just as the less anachronistic concepts of the Renaissance, Reformation and Enlightenment focus our attention on particular countries.

Benjamin Harris *University of Wisconsin, Parkside*

Tabloid Psychology 1920-1940: Did Superstition Win?

This paper examines the changing nature of psychological authority in the U.S. between the World Wars, using an important but previously unexamined

source. According to John Burnham's *How Superstition Won and Science Lost*, psychology was one of many fields in which journalists supplanted scholars as popularizers in the 1930s and beyond, with deplorable results. In my presentation I will examine Burnham's thesis using the Hearst newspapers' Sunday supplement (*American Weekly*) as a primary source. Read by millions each week, this newsprint magazine featured hundreds of articles on psychological topics (at least one extensive article each week). In authorship, these show the classic signs of boundary creation and specialization in science: the philosophers and religious authorities of the early '20s are replaced by university-based psychologists with specialist training and degrees. In content, one sees the laboratory become the locus of scientific authority. Also, topics addressed change from grand moral questions (is the family doomed by the New Morality?) to those amenable to empirical research reported in academic journals. Contrary to Burnham, at least one psychologist (Donald Laird of Colgate University) volunteered to translate his work into tabloid-friendly essays with his own photos to add authority and drama. In Laird's writing and in anonymous articles, published scientific research was woven into coherent discussions of popular topics (e.g., can one read character from facial qualities?). I will conclude with a review of historical approaches to popularization that compete with or complement Burnham's.

Robert Hendrick *St. John's University*

Gender Stereotyping in Visual Images of French Science Popularization,
1870-1914

Perceiving it to be a panacea for problems facing France after 1870, scores of popularizers worked to create a favorable public image of science. Directing their efforts at the middle classes, popularizers found it profitable to foster the ideology of that group. Hence, they made science popularization a means of ideological defense. Since this was a period when growing feminist demands significantly challenged the ideology of the middle classes, one area where the popularizers defended existing dominant assumptions was in their adoption of a negative conception of the role of women in society. This paper examines the stereotypical negative view of women incorporated in the popularization of science and medicine in France from 1870 to 1914. Specifically, it deals with visual images depicting science, and women's relationship to it, in various art forms of the period. Examining how science was portrayed in the Salon art of painters such as Jehan-Georges Vibert, Henri Gervex, Georges Chicotot, and in the sculpture of Louis-Ernest Barrias, makes obvious the gender stereotyping present in images of French science. By comparing these negative portrayals of women in science with illustrations that appeared in newspapers, popular science periodicals, and in science books, I show how the "low" art of the period reinforced the prevailing depreciative perception of women's

intellectual and scientific abilities. For contrast, I will juxtaposition these negative images of women with positive images of male scientists in which they are depicted as heroes of modern life. By examining images of science popularization, I demonstrate that the popularizers' conception of women replicated and defended that of the dominant middle class. Science popularization in France in this period thus simultaneously promoted science and a negative stereotype of women.

Sungook Hong *Institute for the History and Philosophy of Science and Technology, University of Toronto*

'One Faith, One Weight, One Measure':
Language and the History of Units and Standards

My paper aims to examine a recurrent narrative in the history of units and standards. It is a comparison between the existence of different languages and lexicons, on the one hand, and the existence of diverse (and therefore the lack of the standard) weights and measures, on the other. For example, John Swinton stated in 1779 that "people who use measures differing both in size and name speak as it were different languages." My paper traces various appearances of this narrative in John Swinton, John Riggs Miller who wrote the book *Equalization of the Weights and Measures of Great Britain* (1790), John Frederick William Herschel's *Preliminary Discourse*, James Clerk Maxwell's article on "Atom," John Ambrose Fleming's proposal for the establishment of the Standardizing Laboratory, and William Thomson's 1883 lecture on "Electrical Units of Measurement." I will show that some changes in this "linguistic metaphor" through the 18th and 19th centuries were associated with, and mutually reinforced, the idea of "natural" units and standards.

Nicole C. Howard *Indiana University*

The King, the Courtier and the Clockmaker:
Christiaan Huygens and Interpretations of Audience

The issue of the intended audience of a book is one which has recently gained the attention of historians of science. In many cases, natural philosophers had in mind a range of individuals—be they from a religious, political, or philosophical background—whom they wanted to speak to through their work. Therefore, understanding who the author had in mind as their readership can provide an important insight into how they wanted their book to be received and read, and may reveal the importance of specific parts of a work for different individuals. My aim in this talk is to examine such authorial intentions by looking at two of Christiaan Huygens' books on the pendulum clock, the *Horologium* published in 1658 and

the *Horologium Oscillatorium*, Huygens' *magnum opus*, published in 1673. I first discuss the content of both of these works, using them as examples of how Huygens shaped the content his books in order to reach multiple audiences. I then take up the issue of dedicatory copies of texts, examining Huygens' lists of recipients which I have found for both editions of the *Horologium*. By evaluating these lists in conjunction with each book's content, I will argue that Huygens not only targeted a different audience in each part of his book, but he also reached a further audience by using the object of the book as a gift, which some of his recipients might never actually read, but would appreciate. From my discussion I hope to make clear the notion that early modern texts such as Huygens' were not written for a single audience of mathematicians or natural philosophers, but that the book—both as text and as object—was consciously directed toward many groups, including patrons, mathematicians, technicians, and men of letters.

Florence C. Hsia *Wayne State University*

Missionaries, Monks, and Mathématiciens du roi in the Ancien Régime

Much recent work in the history of science has focused on how self-proclaimed experts in natural knowledge, especially members of the new scientific societies and academies, winnowed the reports of early modern European travelers for credibility and inclusion in the growing stock of knowledge about the natural world. Unlike the ideal Merchants of Light who sailed from Francis Bacon's Bensalem in search of knowledge, early modern travelers—sailors, merchants, soldiers, missionaries—spanned the globe for more instrumental purposes, from trade in silks and spices, to the conquest of lands and souls. Yet despite their diverse motivations, skills, and interests, such travelers often voyaged, like Bacon's Merchants of Light, in service to the state. Journeying from metropolitan France to the furthest reaches of French expansionist ambitions in Asia and the Americas, members of Catholic religious orders traversed an unstable terrain of official French endorsement dominated by the Parisian Académie des Sciences, whose doors were closed to members of the religious orders. This paper examines the complex processes by which these religious travelers sought, acquired, or claimed recognition from the French monarchy as expert scientific travelers.

Danian Hu *Yale University*

The "Great Proletarian Scientific Revolution":
Einstein and his relativity during China's "Cultural Revolution"

Einstein's special theory of relativity was first introduced into China in 1917. Within only a few years, relativity had become widely known among Chinese

intellectuals. China's reception of relativity in these early years was fast and almost unanimously positive. Fifty years later however, during the Cultural Revolution, Einstein and his relativity became the targets of organized criticism. This criticism was in general not scientific, but philosophical, ideological, and political. Critics often deliberately confused relativity in physics with relativism in philosophy. They labeled Einstein "the greatest bourgeois reactionary academic authority in natural science," and relativity a "reactionary bourgeois theory". The critics claimed they made Einstein and relativity "targets of revolution" because "Natural science can not be advanced without revolutionizing the theory of relativity." This organized criticism was only a beginning of the so-called unprecedented "proletarian scientific revolution" in China. Ironically, the criticism movement in a sense helped promote the studies on Einstein and relativity in China. One of most significant "by-products" was the publication of the comprehensive three-volume Chinese translation of Einstein's collected works, which were published in 1976, the year when the "Cultural Revolution" ended. In this paper, I will trace the origin and development of the criticism during the "Cultural Revolution". I will pay special attention to the motivations behind Einstein's detractors. Finally, I will discuss the consequences of the criticism and the lessons that may be drawn from this upheaval in Chinese science.

Karl Hufbauer *University of California, Irvine*

J. Robert Oppenheimer's Path to Black Holes

During the winter and spring of 1939, as many leading American physicists were rapidly following up on the announcement of nuclear fission, the prominent theoretical physicist J. Robert Oppenheimer and his Ph.D. candidate Hartland S. Snyder were theorizing about the collapse of massive stars that had exhausted their energy reserves into what have come to be called "black holes." In this paper I first argue that Oppenheimer's academic contacts at Caltech and Mt. Wilson over the preceding decade together with string of near misses in his chosen field set the stage for his astrophysical research. Then I delineate his immediate intellectual path from an interest in the sources of stellar energy to an engagement with the profound yet esoteric problem of stellar collapse, suggesting that Hans Bethe's breakthrough on the first issue was a powerful incentive for work on the second. Next I consider how Oppenheimer and Snyder developed their scenario for a black hole's formation. And finally I discuss the reasons why the contemporary physics and astronomy communities paid so little heed to their findings. Besides illuminating Oppenheimer's career and the history of theoretical astrophysics during the 1930s, this story is of interest for the light that it sheds on the general issues of problem choice and research evaluation in interdisciplinary domains.

Bruce J. Hunt *University of Texas at Austin*

Teaching the History of the Atomic Bomb

For the past 15 years, I have taught a course at the University of Texas on “The History of the Atomic Bomb.” It focuses tightly on events from the discovery of fission in 1938 to the Oppenheimer security hearings in 1954, and combines a detailed examination of the scientific and technical issues involved with extensive treatment of the social and political context. The students are required to write papers analyzing and evaluating the American decision to drop atomic bombs on Japanese cities, and for the purposes of this session, I will focus on how I handle this always controversial subject. I will also discuss how I use the mid-1990s controversy over the Smithsonian’s planned “Enola Gay” exhibit to bring out the continued resonance of the story of the atomic bomb, and to raise broader questions about how history gets written, rewritten, used, and understood.

Sarah E. Igo *Princeton University*

Arguing with Gallup: Popular Challenges to ‘Scientific’ Polling, 1936-1948

In a 1949 article in the *Public Opinion Quarterly*, two social scientists referred to the “traumatic November episode” casting a pall over their field. To anyone in the business of measuring attitudes, the reference was immediately clear: the spectacular failure of opinion polls to predict the outcome of the 1948 presidential election. The article went on to discuss the crucial importance of polling, its public image. The “widespread, relatively prolonged, and intense” adverse public reaction to the inaccurate forecasts, the authors feared, would not only undermine popular acceptance of opinion research but might also “radiate” out to “the more remote field of social science” as a whole. This was especially true if the lesson the public had learned was “the intrinsic unpredictability of human behavior.” The authors of this article, like many of their colleagues, worried about the status of their relatively new field of inquiry. Certain that the only way to acquire legitimacy was through approximating the rhetoric of the hard sciences, but frustrated by their own dependence on variable human subjects, pollsters worked constantly to shore up public confidence in their methods and findings. George Gallup’s claims for “scientific” polling provide a case in point. In his promotional rhetoric, polls were a scientifically-perfectible means for uncovering aggregate national opinion. Even in the years before 1948, however, this characterization did not go uncontested. Popular audiences were fascinated by but also suspicious of “scientific” techniques of opinion-gathering: the intrusiveness of the doorstep interview, the privileging of quantitative over qualitative data, the possibility of public manipulation, and the vision of a systematic science of human attitudes. Drawing upon Gallup’s published works and private papers as well as

contemporary media accounts, this paper concentrates on public debates over opinion research between 1936—when the sample survey method triumphed over straw ballot methods—and 1948. In so doing, it hopes to illuminate the struggles behind opinion polling’s bid for scientific and cultural legitimacy.

Kerri A. Inglis *University of Hawaii*

The Representation and Commodification of Suffering:
Kalaupapa National Historical Park

When foreigners came into contact with the Hawaiian Islands, they brought with them many “foreign” diseases. The result of this biological exchange was the tragic decline of the Hawaiian population. One disease that not only took lives, but influenced a great deal of cultural change was leprosy, or Hansen’s disease. In 1865, King Kamehameha V, signed “An Act to Prevent the Spread of Leprosy,” through which an isolated peninsula on the island of Moloka’i was designated as a place of isolation and exile for those who had contracted the disease. The segregation law would not be terminated until 1969. In 1980, the Kalaupapa National Historical Park was established. Residents, those who suffered from leprosy and were confined to Kalaupapa prior to 1969, remain at Kalaupapa. Tourists hike down, fly in, or ride mules down to the National Park to tour the peninsula and experience the public history of Kalaupapa. This paper will explore how the history of leprosy in Hawai’i is represented by the National Park, how Hawaiians (including current residents) who suffered from the disease are represented (and/or marginalized) by the Park, and it will examine the role of the “tourist” in these representations.

Kenji Ito *Harvard University*

“Culture of Calculating”:
Theory and Practice of Theoretical Physics in the 1920s Japan

This paper aims to ascertain what “theoretical physics” meant in Japan from the late 1910s to the second half of the 1920s, during the time just before quantum mechanics began to be introduced there. I show that “theoretical physics” had dual meanings (a normative meaning and a “practiced meaning”), and how these meanings were rooted in the social and cultural contexts surrounding Japanese physics. By examining how “theory” and “theoretical physics” emerged in dictionaries, popular writings, and academic institutions, I show that the Japanese word for “theory” was strongly connotative of “philosophy,” and that “theoretical physics” was perceived as a philosophical pursuit of “deep principles” in nature. On the other hand, examination of the works of those who were trained as “theoretical physicists” reveals that what

Japanese “theoretical physicists” did was mathematical elaboration of known physical principles, rather than investigation of principles. I locate these practices of “theoretical physicists” within the “culture of calculating” that dominated Japanese physics, where physicists valued calculational skills and indulged in advanced mathematics. Physicists developed such a culture under disciplinary, social, and institutional constraints. First, physics in Japan was in a close contact with mathematics. Japanese physicists shared the same academic society with mathematicians at the universities, physics students received intensive training higher mathematics. Second, social demands also partially shaped the nature of “theoretical physics” in Japan. The technologies that were changing the modernizing Japanese life and landscape, such as electric engineering often required theoretical physicists to work out lengthy calculations. Third, the institutional inflexibility at Japanese universities, where little communication and cooperation existed between different specialties in the 1920s, did not induce young experimentalists to turn to theory nor did it encourage theorists to go beyond the domain of mathematics and to pursue physical meanings of physics.

John P. Jackson *University of Colorado, Boulder*

The Scientist as Social Activist:
The Career of Robert E. Kuttner, 1951-1982

Biochemist Robert E. Kuttner enjoyed academic and research posts at a number of universities and hospitals. Kuttner believed that he had a responsibility to use his scientific expertise in the service of society. Consequently he wrote dozens of articles for popular journals explaining how science could help solve vital social problems of the day. Of particular concern to Kuttner were the racial problems of the United States. Between 1950 and 1980 he wrote about little else. He was that rarest of creatures in the postwar United States a self-proclaimed racist. Kuttner’s popular articles appeared in extremist journals and newspapers, many of them edited by neo-Nazi publisher Willis Carto. Kuttner was not a mere white supremacist, he was a Nordic supremacist, who proclaimed that the Northern European was the “natural leader of the white race.” In his writings, Kuttner maintained that civilization was racial in nature and slavery was a beneficial institution for Negroes who were incapable of self-governance. Kuttner was convinced that the public was being misled by pseudo-scientific propaganda of “racial equality” that was being propagated by Jews and Communists. This paper will explore how someone with Kuttner’s extreme racial views could nonetheless become a scientific expert witness before the Federal Courts and Congress in the 1960s, become the chair of an Anthropology Department in a U.S. university in the 1970s, and enjoy the widespread dissemination of his racial views over a 30 year publishing career. One level of explanation is that Kuttner was part of a well-organized coterie of like-minded individuals who

were very successful in advancing their ideas. Yet beyond the organizational aspects of Kuttner's career is the fact that his racial views were not far removed from views found throughout United States society.

Jeremiah L. James *Harvard University*

Disparate Bonds: Ends and Means in Early Quantum Chemistry

In the standard account of the early development of quantum chemistry two monolithic theory conglomerates clash over the construction of the best quantum mechanical account of chemical bonding. The account provides an oversimplified model of interdisciplinary research both by ignoring significant distinctions between the methods of theorists within each theory conglomerate and by presenting the parent disciplines, physics and chemistry, as undifferentiated wholes. The purpose of this paper is to initiate a more detailed discussion of the development of quantum chemistry through an investigation of the disparate goals and values to which early researchers in the field adhered. To this end it explores two closely related and oft overlooked aspects of some seminal works in quantum chemistry. First, it discusses the place that quantum chemical investigations played in their authors' broader research programs. Early research into quantum chemistry was rarely pursued for its own sake. Rather, it was normally one aspect of a multifaceted drive toward disciplinary expansion or unification. Second it investigates how the authors perceived the relationship between the sundry disciplines they drew upon in constructing their novel theories of the chemical bond. Early quantum chemists borrowed not only from the resources of quantum physics and laboratory chemistry but also from spectroscopy and crystallography and sundry other fields, and the ways in which they integrated these disciplines ranged from strong reductionism to near nominalism.

Dale Jamieson *Carleton College*

Managing Planet Earth: The Rise of Coupled Models and Integrated Assessment

The idea that global environmental change has thrust humans into the role of planetary managers began to gain currency in the late 1970s, gaining momentum throughout the 1980s. Ironically, as the collapse of communism demonstrated the inability of people to manage rationally their own societies, the attractions of planetary management seemed to become more compelling. Beginning in ecology and spreading quickly to other disciplines, global environmental management has come to be seen not just as one policy choice among others, but as an obligation. Would-be planetary managers believe that



the physical and biological sciences can provide a basic understanding of the “earth system” and a diagnosis of what has gone wrong economics and conservation biology can provide solutions. It is the role of government to choose among the solutions and to put them into effect. One way into global change research for social scientists is through what are called “integrated assessments.” The new demand for integrated assessment is not a request for a whole earth dialogue but rather a purchase order for a whole earth model. As it is now understood, integrated assessment is about coupling physical, biological, and economic models. In this talk I will describe and analyze these recent attempts at constructing whole earth models.

Vladimir Jankovic *University of Manchester*

Fear and Medical Politics of the 1999 Solar Eclipse in Serbia

“Leave your Home only if you Have to” was the message which the Serbian Ministry of Health issued on the day of the last August’s Solar Eclipse. In the official statement—published in the majority of daily newspapers and magazines and broadcast on TV and radio—the Ministry of Labor, Health and Social Politics and the Hidro-Meteorological Institute asked Serbian citizens to stay away from the eclipse’s twilight and take precaution if they decide to observe the phenomenon. The statement said that the atmospheric changes during the eclipse may cause hypertension, stomach pains, tachycardia, an increase in blood sugar and an intense itch. These announcements created an unusual sense of anxiety especially as their rhetoric echoed the air-raid warnings issued during that year’s NATO bombardment. In the meantime, the government and opposition parties seized the opportunity to influence public opinion by manipulating medical, meteorological and astronomical information and producing a fascinating mixture of political argument and doom-mongering. In this context, I wish to examine the activities of medical and astronomical establishments and the extent to which their political affiliations affected the construction of public fear.

Sarah Jansen *University of Cambridge/Max Planck Institute for the History of Science*

Arsenic and Candy: The Colorado Beetle in Germany, 1872-1914

“Foreign” insects became an issue in Germany in the early 1870s, during a period of rapid industrialization and of international trade hastened by the introduction of steamboats. The first two insects seen as foreign threats to German (agri-)culture were the grapevine louse and the potato beetle, both of North American origin. These insects assumed twofold cultural positions of increasing

importance in Wilhelmian Germany: the “invading alien” threatening the health of resident populations, and the “destructive machine” of industrialization associated with “America.” Whereas the grapevine louse lives invisibly underground and—when unearthed and placed under the microscope—was perceived as ugly, the Colorado beetle resembles the popular “native” ladybug in its looks: roundish and “cute,” easily visible, and brightly colored, it could have figured in contemporary children’s story books displaying images of anthropomorphized, friendly insects. However, warnings about the beetle had been published since 1872; the first specimen were spotted and eradicated in 1877. The ensuing campaign against the Colorado beetle marks several transitions in the ways insects were perceived around 1900: from cute children’s friends to dangerous foreigners, from companions in everyday life to destructive pests, and from insect collectors’ items to the inaugural objects of emerging economic entomology. The campaign involved such various practices as the production and distribution of hundreds of thousands of candy models of the beetle for educational purposes, the distribution of ‘wanted posters’ in harbors, and the development of material practices such as the application of poisonous compounds to plants and soils. The paper will examine the roles that popular and scientific representations of the Colorado beetle, as well as material techniques directed against it, played in shaping the beetle as a scientific-technological object. Particularly, it will examine how cultural positions, social, economic and scientific practices intersected in the process of its emergence.

Adrian D. Johns *California Institute of Technology*

What We Can Learn From the History of Piracy

Piracy is big news today. Politically, commercially, and socially, it seems set to play an important part in the definition of the global knowledge economy. As digital technologies and the World Wide Web transform the worlds of creativity and intellectual property, so allegations of the offence attain all the more importance. It is therefore not surprising that we tend to think of piracy as only the most dramatic symptom of a “communications revolution” that is radically new. Yet while its current face may be novel, the phenomenon of piracy itself is anything but. In fact, the identification of certain practices as “piratical” dates back hundreds of years, to the invention of the printing press, and it persisted through the emergence of modern forms of science and social order. Piracy and propriety have been in dynamic interaction since the beginning. The very idea of reliable large-scale communication of knowledge in print depended on how that interaction was managed. For that reason, science repeatedly found itself at the very focus of debates over piracy. In the seventeenth century, fear of piracy was an important stimulus to the articulation of common conventions of learned conduct, at places like the Royal Society of London. In the eighteenth, pirates moved to cities like Dublin, Edinburgh, and Neuchatel, and fuelled the

Enlightenment by their activities. And in the nineteenth, the origins of social science occurred during debates over the significance of piracy for the very definition of society. Today, the new world of the life sciences is facing its own brand of “biopiracy” —one that is calling fundamental principles of creativity and intellectual property into question all over again. My presentation will thus seek to put our present concerns into deep historical context. I hope thereby to suggest how a historical understanding of piracy can help us make sense of some urgent questions facing today’s scientific world.

Matthew L. Jones *Columbia University*

Calculating Machinery:

Pascal and Leibniz on Knowledge and Spectacle in the Early Modern State

Blaise Pascal and Gottfried Leibniz offered their calculating machines and techniques as means for augmenting and supplementing current techniques of governing in the early modern state. Both introduced their machines and calculational techniques within a detailed account of the roles of governmental knowledge and spectacle for the smooth running of the state. Both provided their techniques as means to perfect the monarch’s knowledge and to justify and to help produce the faith the people ought to place in their ruler. Despite the gap separating Pascal’s infamous pessimism and Leibniz’s even more infamous optimism, their machines and techniques helped them to articulate their accounts of the deliberate, artificial production of the tangible and intangible elements necessary for producing and maintaining peaceful societies.

Susan D. Jones *University of Colorado*

Creating a Scientific Context for Contingent Knowledge in Veterinary
Medicine

In the late nineteenth and early twentieth centuries, North American veterinary scientists became heavily involved in government-sponsored research on pressing livestock disease problems. Using the cases of Pictou Cattle Disease and Texas Cattle Fever, this paper illustrates the methodologies that veterinary scientists agreed upon as legitimate for identifying the etiologies of animal diseases. Stockmen had long suspected that Pictou Cattle Disease was caused by ingestion of a poisonous plant, and Texas Cattle Fever by an infestation of ticks. As veterinary scientists went about studying these diseases, however, their epistemological loyalty to the tenets of bacteriology guided their investigations. They also continued to rely upon fieldwork, and it served as the conduit through which contingent knowledge and local context entered the realm of scientific explanation. Especially in the case of Texas Cattle Fever, this methodology

yielded innovative results in the scientific understanding of disease causation. Both of these cases demonstrated that, despite reliance on a proprietary epistemology, local experience and ideas helped to shape veterinary scientists' production of knowledge about North American animal disease problems.

Edward Jones-Imhotep *Harvard University*

Ionograms, Identity, and the 'Idea of North'

Throughout much of its history, Canada has imagined itself as a northern nation. In the absence of linguistic or cultural unity to bind the country together, governments and citizens alike have historically turned their gaze northward and have seen in the Canadian geography and climate, and in the hardships they produced, a distinctive identity: an imagined community centred around the famed 'idea of North'. This paper explores how this cultural touchstone played into the more ethereal realm of post-war Canadian ionospheric research, and particularly into the analysis of its most cherished inscription—the panoramic ionogram. Following the Second World War, Canada entered a period of intense self-reflection. Tied ever more loosely to a declining Britain, bound ever more closely to an emerging U.S. superpower, Canada sought to re-imagine itself. In music and literature, in art and film, the nation attempted to fashion a distinctive post-war identity rooted in the image of Canada as a northern land. Scientific research in traditional fields like climatology and geology helped underwrite such claims to northerness, but they were crucially buttressed by less traditional allies. Ionospheric research—struggling to remedy the problems of shortwave radio in the Canadian North, resonating with the profound cultural discourse of communications in Canadian history, and attempting to establish its significance for North American defense and international cooperation during the Cold War—played a critical role in the scientific construction of the 'New Canada of the North'. Marshalling magnetic effects, auroral disturbances and the singular geophysics of northern polar regions behind them, Canadian ionospheric researchers pointed to the visual traces of the ionogram as instantiations of a 'Canadian ionosphere', and came to read in these images the distinctive characteristics and identity of a northern nation.

David Kaiser *Massachusetts Institute of Technology*

On a Wing and a Prayer:

Roger Babson and the Rediscovery of General Relativity

Einstein's theory of gravity, general relativity, fell out of American physicists' curricula during the 1930s and 1940s, yet it returned to some American physicists' research agendas in the mid-1950s. One of the reasons for its return can be traced to a little-known private foundation, the "Gravity Research

Foundation,” funded by an eccentric New England philanthropist, Roger Babson. Babson made no secret of his goals for establishing the Gravity Research Foundation: his undying passion, sparked during his turn-of-the-century undergraduate studies at MIT and fostered by his life-long friendship with Thomas Edison, was to find some means of shielding gravity. On the heels of World War II, Babson dreamed in particular that industrious American scientists could harness the powers of gravity to feed the hungry, comfort the aging—and repel Soviet missiles. The foundation, in other words, was in the business of looking for “anti-gravity,” a business which nearly all of the physicists who came to profit from the foundation’s largesse considered impossible. Even as some of these physicists mocked the foundation among themselves (as surviving correspondence indicates), they dutifully submitted essays to the foundation’s annual essay contest, participated in the foundation’s summer conferences, and worked under the auspices of new gravity-research centers founded and funded in part by Babson’s group. In the process, the topic of general relativity gained a new generation of dedicated researchers and in this process, the conceptual and calculational machinery of general relativity enjoyed renewed scrutiny. Moneyed interests, postwar paranoia, and enterprising essay-contest winners thus worked together to put general relativity back in the minds of American theoretical physicists.

Evelyn Fox Keller *Massachusetts Institute of Technology*

Models and Simulations

Nelson Goodman famously observed, “Few terms are used in popular and scientific discourse more promiscuously than “model.” Much the same might be said of the term “simulation.” Yet this was not always the case. Both words have ancient histories, but until quite recently, the meaning of “simulation” was quite stable, and it invariably implied deceit. Only after WWII that the word took on the meaning that brings it into its current proximity with models. Here, the valence of the term changes decisively: now productive rather than merely deceptive, and, in particular, designating a technique for the promotion of scientific understanding. The shift reflects a crucial change not only in the perceived value of simulation, but also, as others have already noted, in the means of production of scientific knowledge. Furthermore, it is this new sense of the term that encourages its use in much of the current literature as either interchangeable with the term model, or as one part of a single composite noun (as in “models and simulations”). An obvious question arises, however, and it is this: do the actual uses of simulation in contemporary scientific practice in fact warrant such facile assimilation? Or, to pose the question somewhat differently, does the use of simulation in post WWII science add significantly new features to the range of practices that had earlier been subsumed under the term “modeling” ?

Jordan Kellman *Louisiana State University*

Jean Mattieu de Chazelles and the Birth of Naval Science
in 17th-Century France

Jean Mattieu de Chazelles (1657-1710) created the first accurate planispheric projection of the world, created the best maps of the Mediterranean coast of France of the seventeenth century, and proposed the first scientific expedition to find the fabled Southern Continent. Though little known in the history of science or maritime history, Chazelles' career as astronomer at the Paris Observatory under J. D. Cassini (Cassini I) and as professor at the naval academy of Marseilles shows the evolution of a new relationship between science and seafaring, and between observational astronomy and the improvement of the French navy, that was fundamental to the creation of institutional science in early modern France. Using Chazelles' log-books, letters, maps and manuscript notebooks, this paper will trace his efforts to take experience he gained and techniques he learned at the Paris observatory and adapt them to the curriculum at the naval officer training program at the port of Marseilles. Here Chazelles trained a generation of naval officers in the techniques of scientific observation developed by Cassini, including the determination of longitude by the method of Jupiter's moons and the charting of coastlines using a new method of systematic sounding and precise shipboard surveying. Chazelles hoped to use these officers as traveling observers to improve the coastal maps of France and the world, as well as to transform the French navy into an efficient force buttressed by the new techniques of observation. The success of Chazelles' efforts put France at the forefront of naval cartography, and in spite of France's subsequent colonial and naval misfortunes at the hands of the English, Chazelles' work confirmed the idea that scientific research would advance the interests of the French Crown and established scientific training as an integral part of naval education.

Dong-Won Kim *KAIST*

Why Physics?: The Conflicting Role and Image of Physics in South Korea

In South Korea, popular appreciation of physics' practical role has not coincided with the popular view of physicists as primarily theoreticians. Following the end of the Korean War in 1953, successive South Korean governments paid special attention to developing an atomic bomb. The major beneficiary of this obsession for nuclear armament was the South Korean physics community. Despite South Korea's desire for atomic weaponry, South Koreans held experimental (or applied) physics in much lower regard than theoretical physics. In many South Korean universities, the proportion of theoretical physicists was, as still is true today, excessively high. For example, at South Korea's most prestigious institution of

higher learning, Seoul National University, more than half the faculty positions in the department of physics are held by theoreticians. In the South Korean view, the physicist is symbolized by Einstein, the theoretician. What accounts for South Korea's preoccupation with theory over experimentation? The most obvious explanation is offered by the influence of Confucianism in the Korean culture. As a result of this influence, solely intellectual occupations enjoy much higher status than those which require some manual input. The dominance of theoretical over experimental physics began to change only after 1980, when a new military government, under pressure from the United States, finally abandoned South Korea's dream of building an atomic bomb. South Korea focused instead on expanding its electronics capacity, particularly its computer and semi-conductor industries. With the strong backing of the new government, solid-state physics suddenly flourished. Nonetheless, as a result of South Korea's firmly imbedded preference for theory versus practice, solid-state physics and other applied physics disciplines have so far managed to find their place primarily in institutions outside the physics departments of South Korea's traditional universities.

Mi Gyung Kim *North Carolina State University*

Genealogy, Memory, and the Chemical Table

“A Chemical Table is in itself a specable agreeable to the mind,” so declared Bernard le Bovier de Fontenelle, referring to Etienne-Francois Geoffroy's *Table des rapports* of 1718. Fontenelle had been preaching for some time that chemistry could approximate the ‘sublime questions of modern geometry’ which were reduced to ‘universal formula’, if only one could predict the changes corresponding to the different chemical propositions. Geoffroy claimed in his presentation of the table to the Academie des sciences that it would allow chemists to see ‘at a glance’ the different ‘rapports’ of chemical substances, which in turn would help them predict the outcome of complicated chemical actions. He seems to have chosen the word ‘rapport’ instead of ‘affinity’, to exploit deliberately its dual meanings as relationship and as mathematical ratio. Even if Geoffroy's affinity table failed to attain mathematical certainty, it has an inherent appeal as an orderly representation of the seemingly chaotic practice of eighteenth century chemistry, particularly to the modern chemical reader accustomed to the periodic table. As Guyton de Morveau put it a half-century later, after a considerable proliferation of affinity tables, these synoptic chemical tables formed a kind of ‘chemical world map, in which one would perceive at first sight the countries known & the space that remains to be discovered.’ That is, the affinity table and similar devices allowed an instant recall of basic chemical actions which mapped the chemical territory as it was then known and thus served as an instrument of collective memory for the chemical community. It could function as such, however, only in so far as it could efface the technologies of production. In this paper, I would like to follow Foucault's move from archaeology to genealogy to unearth the shifts in chemical techniques which made Geoffroy's table possible.

Ock-Joo C. Kim *Harvard University*

Knowledge Out of Suffering: Harvey Cushing's Brain Tumor Registry

This paper examines Harvey Cushing's production of knowledge on brain tumors from 1913 to 1932. While serving as the surgeon-in-chief at the Peter Bent Brigham Hospital in Boston, Cushing assembled a powerful team of neurosurgeons, pathologists, and physiologists that operated on more than 2,000 patients suffering from brain tumors. Cushing knew that a deeper understanding of brain tumors would come only from his patients. While dedicated to alleviating their suffering, he freely experimented with aggressive, if not always successful, surgical techniques and post-operative care. For Cushing, the therapeutic domain functioned also as a scientific domain to produce knowledge. To systematize this knowledge, Cushing established the Brain Tumor Registry, a long-term project to compile the medical records and case histories of his patients. Using the Registry, Cushing was able to produce landmark monographs on the varieties of brain tumors and the techniques of surgical intervention. Cushing's unusual capability to interplay between the suffering patients and his expert medical group resulted in the Brain Tumor Registry, a lasting legacy in neurosurgery. His case also raises a number of significant historical and ethical questions. How did the patients' experience of diseases affect the process of collection of clinical data? Through what process was the knowledge on brain oncology created from the patient records? What agencies, other than the hospital, participated in the production of knowledge on brain tumors? How was the Brain Tumor Registry related to emerging specialization in neurosurgery and the clinical sciences such as pathology? How was Cushing able to orchestrate all this while at Peter Bent Brigham Hospital, and what does his story reveal about medical care and research in the early twentieth century?

Ann F. La Berge *Virginia Polytechnic Institute and State University*

Dirty Stories:

Investigative Reporting as Scientific Practice
on the 19th-Century French Health Councils

The French health councils are one of the more interesting, yet neglected, scientific institutions of the nineteenth century. They were one of the main sites for the practice of public hygiene. The regular work of the hygienists was investigative reporting: investigating public health problems and then writing narrative accounts of their findings and recommendations. This paper will recount some of the hygienists' stories in their own words, drawn from both manuscript and printed reports of on-site visits and their analyses of public health problems, including epidemics, vaccination, secret remedies, dumps, sewers, public baths, private dwellings, and a host of industrial/occupational concerns. An analysis of these stories will allow us to reappraise the practice of public hygiene in light of

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recent scholarship and new historiographic orientations in the history of science. The work of the hygienists will be analyzed within the context of the political culture of hygienism, a medical imperialism whose goal was to civilize the urban and rural poor in the dwellings and places or work in the interest of public order and national security. More broadly, hygienic science was a key feature of the civilizing mission of the French bourgeoisie both at home and abroad.

Sofie Lachapelle *University of Notre Dame*

Materializing Authority: The 1922 Psychical Experiments at the Sorbonne

The apparent rejection of the supernatural by scientists conceals a complex interaction between science and the pseudo-science of the paranormal. I will discuss one of the most famous of such interactions in French psychical science centered around Eva C.'s seances at the Sorbonne in 1922. In early twentieth-century France, the term psychical science referred to a number of different and sometimes incoherent research methods, subjects of interest, and grievances against the structures of scientific authority. Psychical researchers could either be building a religious science, a popular science, a science of the marvelous, or imitating what was labeled official science. Whether they were hoping to change scientific authority in some way or working towards entering under its mantle, psychical researchers were often engaged in a one-way dialogue with official science. Although there were respectable French scientists of the period interested in psychical phenomena, the official science of the Académie des Sciences and the universities seldom acknowledged the aspirant science. In 1922, however, at the request of a number of psychical researchers, scientists gathered at the Sorbonne for a dozen seances to observe and report on the materializations produced by the medium Eva C. As the negative report of the observers and the outrage that followed in the psychical research press attracted the attention of the media, the Sorbonne experiments became part of a few events around which the scientific and popular presses considered the phenomena and rejected them. Although these investigations into the reality of materializations are not representative of the field of French psychical research as a whole, they, nonetheless, illustrate some of the ways in which psychical researchers contested official science and hoped to build a different scientific authority.

Cherilyn M. Lacy *Hartwick College*

Science Marches Across the Threshold:

From Public Health to Domestic Hygiene in Nineteenth-century France

The French public health movement of the nineteenth century was not concerned with purifying public spaces alone. Hygienists stressed the

importance of improved sanitation within domestic spaces for the success of any municipal or national projects to combat the spread of disease. This paper will begin by examining how prevailing scientific theories of disease causation and transmission (most notably the theory that foul odors, or miasmas, were a source of epidemics) established a link between domestic hygiene and public health. It will move on to analyze the lessons on domestic and personal hygiene in domestic science textbooks, with an eye to how domestic hygiene was described both as the most appropriate science for women to study, and as an essential component in the triumph of science over disease. The paper will conclude with a commentary on the republican fascination with science in the late nineteenth century, with particular emphasis on how the complementary roles of domestic hygiene and public health revised the relationship between home and nation within republican political ideology.

Keith R. Lafortune *University of Notre Dame*

Pickering's Harem and the New Sociology of Astronomy, 1877-1919

Between 1877 and 1919, Harvard College Observatory director Edward Pickering hired more than forty women as “inexpensive assistants” for his research in astrophysics and photographic astronomy. Both fields were young and unestablished at the beginning of this period. The same can be said of Pickering’s assistants, the group often called “Pickering’s Harem.” Some came from the growing ranks of college-educated women. They were all among the first generations of women entering American science. The place of Pickering’s Harem in the history of astronomy remains open for debate. Margaret Rossiter’s concept of “women’s work” stands as the most widely accepted interpretation of the Harem’s experience. “Women’s work,” as Rossiter and other historians have applied it to women entering American science around the turn of the twentieth century, is three-fold: women were hired for “special skills” that fit traditional feminine stereotypes, their work was primarily non-observational, and they did not contribute to the body of scientific theory. This paper is, in part, an appraisal of the applicability of Rossiter’s convention to the experience of Pickering’s Harem. It is also a suggestion for a new approach. I argue that the women of Harvard are best understood within the context of a changing methodology and sociology of astronomy. New research traditions that arose in the wake of astronomy’s incorporation of photography and spectral analysis helped to transform astronomical observation from an event to a process. At the same time, astronomy developed from a science of individuals towards one of research teams. Within this context, the Harvard College Observatory during Pickering’s directorship may be compared to other institutions pursuing a team-based approach to research. Two examples considered are J. C. Kapteyn’s Astronomical Laboratory and the Lowell Observatory during the search for Pluto. All three institutions pursued unestablished lines of research with an unestablished group of researchers.

Hannah L. Landecker *Max Planck Institute for the History of Science*

Microcinema: Time Lapse Cinematography in Biology 1909-1930

This paper addresses the early recruitment of cinematography to microscopical studies of the living cell in the first decades of the twentieth century. Time lapse technique—taking images at regularly spaced intervals, and then projecting the film at 16 frames per second—greatly accelerated the movements and actions of living cells seen on film. This gave access to a whole range of cellular phenomena which happened at a speed too slow for the human observer to perceive. Such dynamic representation of living cells stood in stark contrast to the contemporaneous widespread use of histological techniques which required that the cells first be killed and then stained, creating a still image of a dead cell. The film itself had a different relation to time than other forms of experimental observation or evidence it was a trace of cellular movement or activity that could be repeatedly shown to large audiences, projected at different speeds, forwards or backwards. This historical exploration of the “microcinema” analyses the role of these films as forms of research in which the scientist was the cinematographer, and thus accesses a little-studied area of the history of experimentation.

Susan M. Lanzoni *Harvard University*

On the Common Ground of Experience:
Ludwig Binswanger’s Phenomenological Psychopathology

The analysis of psychopathological experience using the philosophical tools of phenomenology was the central innovation of Ludwig Binswanger’s (1881-1966) *Daseinsanalyse* or “existential analysis.” Along with other Central European psychologists and psychiatrists of his time, Binswanger questioned the application of natural scientific methods to human psychology, and turned to the growing discipline of philosophical anthropology to help define human nature. Yet, as the director of the Swiss Bellevue Asylum from 1911-1956 and a practicing psychiatrist, Binswanger also had more empirical goals. His project was to develop a phenomenological approach that would be wedded both to the psychic realities of individual disturbed patients and to the concern of articulating systematic structures of human existence in the tradition of the human sciences. Rooting his philosophical analysis in patient experience was a way of forging this link, although such a hybrid approach was not without its critics. My paper will examine the tensions and productive insights of Binswanger’s peculiar mix of psychopathological assessment and the philosophical articulation of existential structures. The technique of *Wesenschau* or a “seeing of essences,” as described by Husserl, was the means by which Binswanger analyzed the actions, words and thoughts of schizophrenic and manic patients. These aspects of patient experience were not seen as independent signs of the disorder, but were to be

grasped as a whole, disclosing the existential core of a person. After the publication of Heidegger's *Sein und Zeit* in 1927, Binswanger shifted his phenomenological approach to assess not only the individual consciousness but the inextricably linked complex of the individual situated in his/her world, or "Being-in-the-World" (*In-der-Welt-sein*). Binswanger's first phenomenological case studies appeared in 1931, in which manic utterances and writings were found to reveal the presence of a manic "world," charted by its spatial, temporal, and material dimensions. Despite Heidegger's repudiation of the empirical use of his insights, and the skepticism of some clinical psychiatrists, Binswanger's focus on the extremes of psychopathological experience helped to illuminate phenomenological "worlds," and phenomenological methods "normalized" psychosis insofar as they demonstrated the structural similarities between psychotic and normal experience.

Mark A. Largent *Oregon State University*

Biological Justifications for Progressive Reforms

Historians and historians of science have emphasized the importance to evolutionary theory, particularly Darwinism, to the American progressive movement. They have asserted that Darwinism provided progressive reformers with scientific legitimacy and it reinforced their belief in progress. What specific role did American biologists themselves play in progressive reform movements? Moreover, how did biologists participation in the progressive movement impact them and their profession? By examining several early twentieth-century progressive causes in which natural scientists like William Ritter, David Starr Jordan, Vernon Kellogg, and Charles Davenport participated, this paper will explore the reciprocal relationship between American biologists and progressivism. They provided scientific justifications for progressive initiatives like increased education, the political enfranchisement of women, eugenics, and the international peace movement. At the same time, their participation in social and political causes enhanced their professional status and gave them the opportunity to demonstrate possible applications for evolutionary science that could better the human condition.

Manfred D. Laubichler *Princeton University*

From a Developmental Point of View:

Theories of Development in the Conception of Theoretical Biology

During the early decades of the 20th century theoretical biology emerged as a discourse among experimental biologists and philosophers. Even though scientists from a variety of different experimental disciplines contributed to these

discussions surrounding the conceptual foundations of biology, questions of development were at the core of all theoretical systems proposed in those decades. In this paper I will discuss the importance of development in the formulation of theoretical biology and the central role of developmental processes in the rhetorical arguments for the independence of biology from physics and chemistry. I will analyze how the increased popularity of neo-vitalistic arguments in the wake of Driesch's popularization of these ideas led to the emergence of theoretical biology as a search for alternatives to the age old mechanist-vitalist divide. Specifically, I will show how certain key concepts that emerged in the context of experimental research programs, such as Hans Spemann's organizer, Alexander Gurwitsch's morphogenetic field, Ludwig von Bertalanffy's organismal systems, or Oskar Vogt's eunomic series were incorporated into conceptual systems about the foundations of biology. I will also show how these conceptual developments were enabled by the organizational efforts of a small number of people (Julius Schaxel, Wilhelm Roux, Vladislav Ruzicka, Adolf Meyer-Abich among others) who controlled and established various series of monographs and scientific journals and actively promoted the idea of theoretical biology.

André R. LeBlanc *CIRST, Université du Québec à Montréal*

On Negative Hallucinations and the Origins of the Unconscious

This paper examines a little-known debate over the nature of negative hallucinations in the late 1880s France. Negative hallucination is the phenomenon by which an object is rendered invisible to a hypnotic subject. The study of negative hallucination produced one of the earliest arguments for the existence of the unconscious. Through a series of intricate experiments, investigators like the philosopher Pierre Janet (1859-1947), the psychologist Alfred Binet (1857-1911) and the physician Hippolyte Bernheim (1840-1919) showed that subjects were somehow still able to see the invisible objects that they could not presumably see. Janet seemed to solve this mystery by demonstrating, in 1887, that a dissociated consciousness saw the invisible objects without the subject's main consciousness knowing it. This was the first experimental application of the concept of dissociation, which was introduced the preceding year, in 1886, and which has become so prominent in recent years with the epidemic of multiple personality disorder, renamed dissociative identity disorder in 1994. Dissociation (then as now) seemed the only way of explaining the phenomenon. In 1889, however, the Belgian philosopher and psychologist Joseph Delboeuf (1831-1896) began arguing in favour of a sophisticated form of simulation and against state theories of hypnosis. His work undermined the then burgeoning theory of the unconscious and, as this paper will show, is still relevant to current debates over the nature of hypnosis and allied mental disorders. More specifically, I believe Delboeuf indirectly demonstrated that the concept of dissociation could never be proven and I will give a book prize to the first person who shows that I am wrong.

Christophe Lecuyer *Dibner Institute for the History of Science and Technology*

Instrumentalizing Medicine:

Physics Research, Medical Practice, and the Development of Linear Accelerators for Cancer Therapy at Stanford University and Varian Associates, 1952-1975

To understand the making of science-based medicine in the postwar period, we need to examine the ways in which new medical technologies are constructed and integrated into the hospital environment. In this paper, we trace the development of a key medical instrument, the clinical linear electron accelerator (clinac), from its origin in high energy physics research in the early 1950s to its widespread adoption for cancer treatment in the 1970s. In particular, we explore the processes by which physicists, engineers, and medical doctors at Stanford University and Varian Associates transformed linear accelerators from research instruments in particle physics into medical tools for the treatment of many forms of cancer. Special attention is devoted to the development of new accelerator designs for clinical therapy at Stanford's microwave laboratory and Varian Associates. We also investigate the development of associated medical techniques and procedures and the training of physicians skilled in the use of clinacs at Stanford's radiology department, as well as the roles of patients' expectations, the professional values and culture of radiology, and the "War on Cancer" programs supported by the Federal Government, in the widespread adoption of this therapeutic technology.

Susan E. Lederer *Yale University*

Celluloid Science: Teaching Science Using Popular Film in the 1930s and 40s

In 1937 the Progressive Education Association established a motion picture project as one of the activities of its Commission on Human Relations. Overseen by educator Alice Keliher and funded by the Rockefeller Foundation, the motion picture project involved editing films made in Hollywood for theatrical showings that could then be shown to audiences of high school students, college students, and adults. As part of its work, the Commission developed study guides containing both sample discussion questions and additional readings for the discussion leaders. Moreover, the educators screened each of the selected films for audiences in twenty schools, and made stenographic records of the discussion that followed the film. The aim of the program was not science education per se, but several films on the roster, notably *The Story of Louis Pasteur* and *Arrowsmith*, encompassed issues relating to the nature of scientific discovery and research ethics. The richness of this material makes it a useful starting point for an exploration of the uses of "screen science" in the 1930s

and 1940s. This paper analyzes the choices Keliher and her colleagues made in selecting films and film clips for educational purposes, and the issues educators identified in the study guides. More than that, it seeks to expand current understanding of science popularization in the first part of the twentieth century by examining the reception of popular films featuring heroic scientists, both fictional and historical. By historicizing the pedagogical utility of such films as *Pasteur*, this paper suggests ways to enrich contemporary teaching in the history of science using popular films depicting scientists and the process of scientific discovery.

Wolfgang Lefèvre *Max Planck Institute for the History of Science*

Drawings in Ancient Treatises on Mechanics

Up to and including the time when our modern critical editions of the ancient treatises on mechanics appeared, around 1900, scholars did not treat the drawings in these treatises with the same historical spirit as the text. Even in cases where such drawings were undoubtedly derivatives of the original ancient figures, they were regarded as being awkward and evidence of a poor level of drawing techniques. This paper tries to show, on the contrary, that we can still recognize in these derivatives features of highly elaborate drawing techniques used by the ancients. The thesis of the paper is that these features add up to a particular syntax of drawing that was characteristic of ancient mechanics.

Timothy Lenoir *Stanford University*

Accelerating Discovery: Bioinformatics and Interdisciplinarity

From the 1960s through the 1990s leading biologists and program officers of major funding agencies such as the NIH emphasized the need for biologists to emulate the models of interdisciplinary research and multi-disciplinary teamwork in successful physics projects such as the Manhattan Project and other big science projects. The field of bioinformatics is one of the successful offspring of these campaigns. Bioinformatics is a new highly interdisciplinary field deriving from work in biological disciplines such as molecular biology, genetics, and evolutionary systematics. The concepts and experimental data of these areas have been radically extended and operationalized through the infusion of tools from a wide array of areas in computer science and engineering, such as information theory, statistics and probability, graph theory, algorithms, artificial intelligence, data bases, machine learning, and robotics. These tools and technologies more than anything else have shaped biology as an information science. On the one hand the tools and technologies of information science have driven an exponential explosion of new data. On the

other hand, in order to cope with this data ever more advanced techniques from information science, particularly techniques of automation and machine learning, have become staples of biological work. What has been the cost of this transformation? Drawing upon the case of bioinformatics, this paper will explore several contexts for advocating tools of information science as the vehicle for making biology interdisciplinary, and the political economy of accelerated knowledge production that has been both cause and effect in reshaping biology as an information science.

Trevor H. Levere *Institute for the History and Philosophy of Science and Technology*

Cosmopolitan Isolates at Home and Abroad:
Chemists and Physicians in the 1780s and 1790s

From 1780 until 1787, the Chapter Coffee House Society, a group of chemists, physicians, instrument makers, and engineers, met in London. The members had strong ties with the Lunar Society of Birmingham, with political and religious dissent, and with Edinburgh University. Even though many of them were Fellows of the Royal Society of London, they formed a group whose centre of gravity and influence lay outside the establishment. One of their constant refrains was the insularity of British science, and the lack of ties between British and continental men of science. And yet at almost every meeting, discussion would include reports and criticism of the very latest science abroad, in Germany, Italy, France, Sweden, the Netherlands, and beyond. Magellan, Portuguese priest, natural philosopher, and, most probably, industrial spy, was the one-man centre of a highly effective scientific intelligence network. Kirwan was in close touch with French chemists and the latest chemistry. Others reported on work in German-speaking Europe before it was published in Crell's *Annalen*. Correspondence, travel abroad and visits from foreign travellers, reinforced by the exchange of publications, meant that the members of the Chapter Coffee House Society were singularly well informed about European science. Thomas Beddoes was one among their many sources for continental intelligence. Beddoes was not himself a member of the Society, but he was known to many of its members. His information, translations of German and Swedish texts, later complaints about the Bodleian library's inadequate holdings in German science, numerous reviews of German works in British periodicals, and the strong representation of German science, literature, and philosophy in his own personal library, all attest to the presence, in at least some English quarters, of a lively awareness of the latest developments in European science and medicine. His encouragement of Coleridge's visit to Germany was just one fruitful manifestation of this awareness.

Tanya J. Levin *Johns Hopkins University*

Winning the Hearts and Minds of Third World Peoples:
US Oceanography during the Cold War

In the late 1950s and 1960s United States oceanographers stated that they could find resources that would help feed the malnourished inhabitants of developing nations. In asserting this claim, oceanographers hoped to convince African, Asian, and Latin American nations that it was in their interest to allow scientists access to their territorial waters. Moreover, by asserting their ability to increase fisheries' knowledge oceanographers also sought the support and funding of US politicians and agencies for their research. Marine scientists' commitment to aiding developing nations dovetailed with the US government's desire to increase political stability and win allies in unaligned nations. The International Indian Ocean Expedition (1961-1966) represented an opportunity for oceanographers to put their humanitarian rhetoric into practice for the benefit of India and East Africa. However, oceanographers failed to deliver on their promise to find oceanic nutrients. They concentrated upon fundamental research and neglected applied fisheries' problems. Meanwhile, scientists in developing nations, savvy to the increased attention paid to them, used US oceanographers' discourse to advance their own interests.

Theresa Levitt *Harvard University*

Regenerated Art and Engineering Drawing:
The Jacobin Foundations of the Ecole Polytechnique

The revolutionary campaign for worker education reached its high point under the Terror with plans for the *Ecole Centrale des Travaux publics* (soon to be renamed the *Ecole polytechnique*). At the heart of this "Education des artistes" was the push to convey information through the practice of drawing. The republican worker, claimed founder and Jacobin leader Gaspard Monge, must rely upon the skill of the hand and not the abstract laws that characterized the Academic drawing of the Ancien Regime. This paper examines one aspect of this practice of representation, color theory, through the institutional structure of the *Ecole polytechnique* and its intersection with the regenerated art movement of 1793. It claims that the critique of Newtonian color theory that one finds within the school drew upon claims for an embodied mode of depicting and a rejection of abstract laws.

Shang-Jen Li *Wellcome Institute for the History of Medicine*

Woman and Worm: Gender and Patrick Manson's Parasitological Research

In his early career in China, Patrick Manson (1844-1922), the so-called 'father

of tropical medicine', discovered that the mosquito was the intermediate host of the filarial worm that caused elephantiasis. This discovery initiated a new research orientation in tropical medicine and parasitology. In his research, Manson conceptualized the mosquito as the 'nurse' of filarial embryos. This paper analyzes the relation between Manson's concept and nineteenth-century theories of the sexual division of labour in nature's economy. Moreover, Manson's understanding of the role of the intermediate host was related to the concerns of British medical men about the maternal functions of European women and the role of native wet-nurses in European domestic arrangements in China. British medical men held that European women in China were too debilitated by the climate to nurse their children and the reliance on native wet-nurses was inevitable. However, the presence of the natives in the household and their influence on the children often caused great anxiety among the Europeans. The employment of native wet-nurses caused heated discussions and debates. By exploring the role of gender in Manson's parasitological research, I show that his idea of nature's order was closely related to European gender norms at the periphery of the empire.

Monica Libell *Lund University, Sweden*

Physiology, Civilization and the Pain of Vivisection

In the latter part of the nineteenth century, the educated Western world became highly interested in the expanding methodology of physiology-vivisection. For that society, compassion for suffering beings appears to have been central to the idea of civilization. In this paper, I will discuss how the notion of pain/suffering was played out in the rhetoric of the antagonists within the German vivisection debate. The image of "civilized man" entailed a belief in kindness and compassion which prohibited the infliction of wanton pain. It was against this backdrop that physiologists in pursuit of "scientific medicine" had to impress the significance of their work for medical advancement while simultaneously contending with a growing public concern with the suffering of animals. Much of their research, however, was not initially intended to advance, not did it immediately translate into, medical therapy. Certain rhetorical strategies, therefore, needed to be adopted. Such scientists esteemed "civilized man" no less than did their adversaries, and they anxiously presented themselves as servants of mankind primarily concerned with, and sensitive to pain. Animals, however, being commonly thought of as inferior to humans, could legitimately be used by man for his needs. Consequently, only unnecessary pain was presented as offensive and uncivilized. Physiologists also attempted to bolster their image by appropriating the public's trust in "the good house doctor" whose foremost duties were commonly associated with the alleviation of pain and with the healing and comforting of the patient. Although at a remove from that patient, experimental physiologists eagerly

embraced the reassuring image of the intimate and trustworthy bedside friend. It is difficult to establish exactly how successful was the rhetoric employed by such physiologists. Legislation, the consolidation of the profession, and the therapeutic advances of the early twentieth century came to their rescue.

Jongtae Lim *Harvard-Yenching Institute*

Taming the Spherical Earth and “Globalizing” the Traditional Cosmology
in the Late Choson Dynasty Korea

This paper examines how Korean intellectuals in the eighteenth and nineteenth centuries dealt with the discrepancies between traditional cosmology and a newly introduced Western concept, the sphericity of the earth. This concept apparently conflicted with the major indigenous cosmological schemes such as Sinocentric geographical thought and the correlative relationship between heaven and earth. These schemes, implicitly or explicitly, assumed a relatively small, square earth, at the center of which lay China, the only civilization of the world. The concept of the spherical earth associated with the Jesuit world maps, however, negated any special center on the surface of the earth and suggested much wider world of the “Five Continents.” How did Korean intellectuals, who thought of themselves as the inheritors of the Chinese civilization after the fall of the Ming dynasty, solve these discrepancies? Most of them tried to find a middle ground by incorporating the concept of the spherical earth into traditional cosmology. They accepted the concept concerning just the physical shape of the earth, while excluding its heretical implications. However, the traditional cosmology had also to be revised without giving up its core, the centrality of Chinese civilization. Korean intellectuals, thus, proposed several revised schemes in which the traditional cosmology could be applied to the global level. Yi Ik (1681-1763), a good representative of this kind of enterprise, used the geomagnetic variances reported by a Jesuit missionaries to draw a new metaphysical demarcation of yin and yang on the surface of the earth and placed China at the center of the yang region. This case shows that Jesuit science, however cogent it seemed, was not sufficient to replace traditional worldview, which had enough flexibility to incorporate foreign elements into its own web.

David C. Lindberg *University of Wisconsin, Madison*

Teaching the History of Science and Religion in a Public University:
Pitfalls and Opportunities

Opportunities and challenges encountered in a course on the historical relations of science and religion taught at the University of Wisconsin by David Lindberg and Ronald Numbers.

Susan Lindee *University of Pennsylvania*

Science Students and the Science Wars

Many of the undergraduates I teach are science students of various kinds. This spring I opened my junior-level methods seminar with several (varied) readings relating to the science wars, and found in our discussion that many of the students were attracted to the arguments of Gross and Leavitt and Alan Sokal. I wanted to permit this attraction, to let the students think through what was appealing about such arguments and let them discuss the science wars in ways that made them comfortable. At the same time, I wanted them (eventually) to be aware of some of the weaknesses of such claims, and to be aware of the broader context surrounding them. In my comments for this session, I will speak generally to the problem of not foreclosing alternative interpretations when a topic is sensitive, of immediate interest to the professor, or awkward for the students. I think the science wars pose just such a problem, when the differences between the perspective of the professor and that of the students can be obvious even to the average sophomore. How can a sensitive topic be presented and discussed in ways that both convey the intended message and permit students to explore other messages? In my view, squelching any talk sympathetic to Alan Sokal would have been a poor response. Yet I struggled with how much to say as the discussion progressed.

Abigail J. Lustig *Max Planck Institute for the History of Science*

Natural Atheology and Evolutionary Explanations of the Origins of Religion

It is generally seen as unfortunate when scientists let their religious or other metaphysical beliefs inform their science, which is supposed to be free of external values. But the aims of evolutionary biology, which descends on one side from theology, entail the extension of an *a priori* metaphysical rationalism whose original aim was to upset the strongest rational argument for the existence of God. I make this argument in two parts: In the first, I discuss the way that Darwin's own work transformed and subverted the literature of natural theology, while retaining certain of its key presumptions. In the second, I will talk about post-Darwinian evolutionary biology and the ways that these pieces of covert theological reasoning have shaped the modern science both from within and in its larger cultural context, using the example of modern evolutionary theories about the origins of religion.

Jane Maienschein *Arizona State University*

On the Organism in Development and Heredity

As Oscar Hertwig pointed out a century ago, the central biological problem of the day concerned preformation and epigenesis: which is more important for organic development? Does an organism begin preformed in some sense and just grow larger, or does that form and organization emerge gradually during development? And how? This fundamental problem of morphogenesis was thus a concern of both structure and function, of pattern and process, of morphology and physiology. As E. B. Wilson pointed out, these were at root issues concerning *The Cell in Development and Heredity*. And the questions could be approached through several alternative epistemological frameworks. Investigation in the 1890s did not solve all the problems, of course, and the intervening 100 years has seen a waxing and waning of various strategic attacks. Along the way, it has become clear that we are not even quite sure what counts as an organism, and how organisms are organized. Yet, as a special issue of *Science* reported recently, “unlike human centenarians who are reaching the end of life, developmental biology is basking in its full-blown prime. Indeed the excitement and promise of the field have never been greater, as researchers close in on the secret of how a single fertilized egg cell goes through the complex and beautifully orchestrated series of changes that create an entire organism.” (1994. 266, p. 561) This is an ideal time to reflect on issues of what counts as an organism, how we know, and what we have learned during a sequence of efforts to study development and heredity.

David McGee *University of Toronto / Max Planck Institute for the History of Science*

William Petty’s Double-Bottom

On December 6, 1864, Samuel Pepys and Sir Anthony Deane proposed a series of wagers to Sir William Petty with respect to the performance of the experimental ship Petty was building in Dublin. They even offered to double their bets if Petty would actually sail in the vessel on its maiden trials. If accepted, the proposed wagers would have amount to more than £2000, which was an awful lot of money in those days. How could Pepys and Deane be so sure they would win? Pepys, was of course, the former Secretary of the Navy. Deane was the leading English naval architect of his generation, and regarded as the first to be able to successfully apply physical theory in calculating the displacement of the ships he designed. This paper takes advantage of the differences in approach to the application of theory by Deane and Petty, particularly the use of measured plan drawings, in order to explain what went wrong with Petty’s foray into shipbuilding, but also to explain features of the relationship between science and design that historians must take into account in order to understand the problematic relations of science and early modern technology.

Erin H. McLeary *University of Pennsylvania*

War Pathologies/the Pathology of War:
Museum Collecting in the First World War

For physicians and medical researchers involved in the treatment and prevention of injury and disease during the Great War, trench diseases, mustard gas, influenza, and above all, modern artillery posed new and painful types of problems. This paper examines the response of one group of medical scientists, those of the Museum Unit of the American Expeditionary Force. In the face of a set of new and horrific pathologies, these scientists responded by employing an old method derived from natural history practice: they collected. In total, the Army Medical Museum in Washington, D.C., received from the AEF approximately 15,000 specimens illustrative of war-induced pathologies. Why did these scientists apply the methods of the field sciences to the medical problems posed by modern war? The collection of specimens illustrating the injuries and diseases of war was not a new medical pastime. The Army Medical Museum had been founded to serve as a repository for specimens from the Civil War. But, by the time of World War I, as AEF Colonel Louis Wilson noted, such collecting “would seem to have relatively little place in a military expeditionary force.” Yet to a certain scientific and medical mindset, field collecting seemed an inherently logical method of organizing and systematizing new knowledge, and arranging specimens into exhibits seemed to provide a natural means for diffusing that knowledge among researchers and medical practitioners. The logic of the museum medium, however, was not always apparent to military commanders. And precisely because these war specimens were organized within a museum setting, they functioned as more than mere examples of novel injuries. The collection and cataloguing of war specimens was at once a source of therapeutic optimism to observers who noted the stimulating effects of war upon progress in science and medicine, and a literal embodiment of the horrors of a war fought with new types of killing technologies. Collected on the battlefield and in base hospitals, the specimens were “the true flowers of blood and pain.”

Susan A. Miller *University of Pennsylvania*

Health in the Balance:

Learning Lessons from the Landscape at Girls’ Summer Camps, 1910-1939

The 1926 edition of Porter Sargent’s *Guide to Summer Camps*, “an invaluable resource for discriminating parents,” heartily endorsed the Girl Scout camping program for its positive health benefits. The Scout program was “carefully planned to teach good health and to develop character.” Scouting leadership could not have agreed more. From their inception in 1912, the Girl Scouts—

along with rival organizations such as the Camp Fire Girls and the YWCA's Girl Reserves—promoted camping programs as the logical successors to the Nature Study movement. Educators, whose plans to create a healthy and holistic environment for children were thwarted by the stuffy confines of the classroom, turned enthusiastically to the great outdoors. Camp leaders, women drawn from the ranks of Progressive educators and social workers, created their immensely popular programs by combining familiar classroom health charts with a rhetoric that emphasized the special, indeed nearly magical, healing powers of nature. On one hand girls learned that acquiring healthy habits at camp was a clinical, if not scientific, undertaking. When they enrolled, girls received a “thorough medical exam” upon which was based a “constructive physical program” for the ensuing weeks. The successful completion of their individualized program, however, rested on their own willingness to adopt a new attitude toward health. Camp was the place where girls learned to keep the health charts that hung at the foot of their beds, as well as “the place to acquire a scientific rather than emotional point of view about food.” Although the possibility for round-the-clock supervision no doubt made it easier for leaders to ensure girls learned these lessons, growth charts and “scientifically-planned menus” were not the only things girls were meant to take home from summer camp. Far from the classrooms they presided over during the school year, leaders tried to impress upon their charges lessons that could only be learned from the landscape itself. Lessons of nature were applicable to both mental and physical health. The “hills and valleys” that together formed the “natural beauty of camp” recalled the “highs and lows” that all girls experienced, and which in concert formed a “well-balanced personality.” Likewise the camp swimming hole taught a cautionary tale about obsession over weight. A girl needed both “strength and fat” to balance the demands of fitness and buoyancy that would guide her safely across the water. Girls were taught that their continued health and well-being, like that of the nature around them, depended on the maintenance of a careful balance.

Gregg Mitman *University of Minnesota*

Hay Fever Holiday: Health, Leisure, and Place in Gilded Age America

By the 1880s, hay fever had become the pride of America's leisure class and the base of a substantial tourist economy that catered to a culture of escape. In mid-August, thousands of hay fever sufferers fled to the White Mountains of New Hampshire, to the shores of Lake Superior, or to the Colorado plateau, seeking refuge from the watery eyes, flowing nose, sneezing fits, and attacks of asthma that developed with seasonal regularity. Through a comparative regional analysis, this paper explores how the geography of place became integral to the defining characteristics of hay fever resorts and the experience of chronic illness: in the very material relationships of daily life, in the social contours of particular regions, and in the symbolic spaces that nature inhabited.

Bruce T. Moran *University of Nevada, Reno*

Libavius, Polemics & Alchemy:
The Transmutation of Emotions and Rationality

One can't read far in Libavius's polemical writings without confronting amazing mixtures of emotional, moral, and cognitive reasoning. Despite the practical and analytical works for which he is best known, and his sometime image as a stern German gymnasiarch, Libavius was a passionate man and a passionate writer. His emotions, like most emotions, were based in beliefs, that is, they contained a cognitive underpinning. Aristotle can be used to show how emotions were thought to be rooted not only in individual psychology, but also in social interaction. Libavius is an angry writer when it comes to condemning Paracelsian secrecy and mysticism, and anger is an intensely social emotion—all the more so since the social emotions reflected in Libavius's diatribes were played out not within strictly dyadic relationships but included an audience, a reading public. Anger (an emotion prompted by a belief about another's actions) clearly turns to hate (a response to a belief about another's character) the latter, I will argue, becomes a durable passion consistent with rational choice and action. In this regard, Libavius wished his adversaries to feel shame while taking pride in his ability to endure abuse and thus being immune from the same emotion. As Aristotle notes, it is for voluntary actions that shame is felt, and a good man will never voluntarily do bad things. In this sense an emotion itself becomes the object of cognition. On a wider level my claim will be that paying attention to emotional responses such as contained in Libavius's polemical writings should be part of the work of the historian of science. Emotional constructions should be accorded relevance not just as rhetoric but as elements in the cognitive constitution of ideas, arguments, as well as social norms. Only in this way, I would argue, can we find in the use of language and in the interplay of ideas a way to relate emotional being (including behaviors, moral judgements, as well as feelings of shame, guilt, anger and the rest) to culturally influenced rational choices and decisions.

Mary S. Morgan *London School of Economics and University of Amsterdam*

Thought Experiments and the Generation of Economic "Evidence"

Verbal reasoning from thought experiments is a traditional form of argument in economics. From the 1930s, economists began to abandon verbal versions of these experiments in favour of a more structured form which relied on the use of mathematical and statistical models as a technology to extend the powers of the mind. In one type of practise, these experiments used models to explore the implications, limitations and range of applicability of economic theories.

For example, the 1930s mathematical models of the macro-economy were developed as an aid to understand Keynes, new theory and as an instrument to demonstrate how it differed from the older “classical” theories. In another type of practise, these thought experiments used models along with simulation techniques with the aim of mimicking economic observations or certain generic characteristics of such observations. The 1930s simulation of business cycle data and of certain characteristics cycle lengths begins this usage, which re-appears again in the 1980s. This paper examines how these changes in the form of reasoning with thought experiments occurred, how they were received in the profession, and how they became embedded as an acceptable style and form of argument to become standard in the post 1950s period.

Iwan R. Morus *Queen's University, Belfast*

Mastering the Invisible:
Technologies of the Unseen at the Mid-Victorian Exhibition

Mid-Victorian exhibitions were places where science and showmanship crossed paths. Audiences thronged there to witness the latest technological and philosophical marvels. By the 1860s, the Royal Polytechnic Institution on London's Regent Street had a long history as an exhibition space. It was firmly established in Londoners' eyes as one of the metropolis' premier sites for the witnessing of wonders. In the early 1860s, Professor Pepper, the Institution's resident lecturer, mounted a spectacular new exhibit: he showed a ghost on stage. Pepper's Ghost challenged the audience to match his ingenuity. What was on show as much as anything else was the skill and scientific knowledge Pepper could marshal to fool his audience into seeing what wasn't there. Pepper and others used the Ghost—and the space the Polytechnic provided them—to try to establish themselves as authorities on the possibilities and limitations of science. Focussing on the Royal Polytechnic Institution, this paper looks at this episode and other examples as instances of the ways in which ingenious displays of the invisible, the impossible or the intangible could be used in efforts to establish new claims to cultural authority by new groups and new kinds of individuals in the mid-Victorian period. It shows how mastery over technologies that appeared to contest Victorian perceptions of the boundary between real and unreal could be used to challenge received wisdom and bolster alternative claims to expertise.

David P. D. Munns *Johns Hopkins University*

Becoming Astronomy: Why Cosmic Noise became Radio Astronomy

Too many disciplinary stories emphasize the novel creation of new fields of scientific inquiry. But for the post-1945 sciences I argue for the increasing

entrenchment of conservatism and preservation of established disciplinary modes—research agendas, institutional foci, publication outlets, and pedagogical statutes. This paper will look at radio astronomy in the United States and Australia, examining the conscious choice of participants in each locale to move away from a physicist/electrical engineering orientated science, labeled ‘solar’ or ‘cosmic noise,’ toward an astronomical science. Moreover, the cases of the United States and Australia shows that this process functioned in both directions. Astronomers at Harvard adopted radio astronomy to bolster a failing program, physicists in Australia wedded themselves to Australia’s pre-eminent science, astronomy, to gain intellectual merit. The result in each case was the rapid establishment of a field, radio astronomy, which celebrated its fundamental nature and increasingly won greater material resources by essentially imitating optical astronomy. The laboratory became the observatory and the aerial became the telescope. Radio astronomy is entirely the product of the post-1945 science environment. Like the usual subjects of ‘cold war’ science—nuclear research, human genome—radio astronomers rapidly moved towards the erection of huge instruments, by the 1960s rivaling even optical astronomy. Yet, unlike the usual suspects, radio astronomers adamantly maintained their commitment to ‘fundamental’ science. The texture of the science’s development emerges from the tension implicit in expansion towards no fixed practical goal.

Heather Munro Prescott *Central Connecticut State University*

“I Was A Teen-Age Dwarf,” or What is “Normal” Adolescent Development?

In his best-selling novel *I Was a Teen-Age Dwarf* (1959), Max Shulman describes the woes of adolescent protagonist Dobie Gillis, a young man who strives for success in life and love despite being utterly average in every way. A sequel to Shulman’s *The Many Loves of Dobie Gillis*, which inspired the television show of the same name, *Dwarf* opens by describing thirteen-year-old Dobie’s distress about being shorter than his eighth-grade classmates at John Marshall Junior High School. Although the school nurse, Miss Finsterwald, tries to assure him that according to the growth chart in her office, his height of 62.6 inches is exactly average for a boy his age, Dobie does not buy it. “Well, I don’t know who made up this chart,” says Dobie, “but I’ll bet my last nickel that either they were drunk or else they did their research among the pygmies of Central Africa.” If 62.6 inches was the average for thirteen-year-old boys, asks Dobie, then why was every thirteen-year-old boy at John Marshall Junior High taller than him? Worse yet, why was almost every thirteen-year-old girl taller than him? Dobie asks his father why girls his age are so much taller than boys. “Do you think it has something to do with the atomic bomb,” Dobie asks. Dobie’s father blames the phenomenon of tall women on a “series of catastrophes beginning with universal suffrage” that has turned modern American society into a “matriarchy.” Back in the old days, says Pa, “when women looked up to their men, they had to be short.” Now that women were in charge,

claims Pa, they have the size to match it. “That, my son, is why girls are growing so tall.” Dobie’s mother, however, simply tells him not to worry. “I will soon have my fourteenth birthday and Ma says Dr. Gesell, who knows everything, says that fourteen is the year of greatest growth for boys.” Dobie remains on the short side of average, only reaching five foot six, but by the end of the novel, at age thirty, comes to accept that “runts can be happy.” Nevertheless, Dobie marries Chloe, “a small weak girl who is exactly the kind of girl I require since I am a small weak man.” The passage described above is a typical example of mid-twentieth century confusion about what constituted “normal” adolescent growth and development. For several decades, scientists in the field of child development had been trying to establish the developmental norms for children and adolescents, and disseminate this information to a popular audience through parent education groups, advice manuals, and columns in newspapers and magazines. Like Dobie, teenagers who did not fit the physiological, anatomical, or behavioral standards established by developmental research worried that they were “abnormal.” At the same time, adolescents who did not conform to standardized height and weight charts became targets of new medical therapies in pediatric endocrinology and surgery. In addition, as Pa Gillis’ quip about the affects of the “matriarchy” on female growth implies, scientific interest in the bodies of adolescents have been shaped by larger cultural notions about what constitutes “normality.” I will show that developmental researchers reinforced the existing social order by defining normal adolescent development in terms of larger cultural notions about masculinity and femininity. Developmental research was also influenced by prevailing assumptions about race and class. White, middle-class adolescents formed the majority of research subjects, since researchers wanted to exclude “contaminating” factors such as race and class from their study of “normal” development. Other historians have mentioned these unexamined assumptions about gender, race, and class, but have not explored how they influenced scientific thought or medical therapy. Finally, this paper will show that contemporary views about what constitutes “normal” adolescence continues to be influenced by physical and psychological standards established by the mid-twentieth century.

Michelle Murphy *Max Planck Institute for the History of Science*

Buildings for Bodies:

Ordinary Places, Chemical Exposures, and the Politics of (Im)Perceptibility
in the Late Twentieth Century U.S.

How do buildings affect bodies? In the late twentieth century the multiple answers to this question, articulated differently by lay people, engineers, toxicologists, and environmentalists, have grappled with each other, creating an agonistic political field around the problem of low-level chemical exposure. Pivotal to this politics is not only how the corporeal effects of chemicals can be rendered perceptible, but also what is rendered imperceptible. This paper

takes as its task historicizing objects—buildings and bodies—as embedded in multiplicities that constitute precipitabilities and imperceptibilities. It argues that buildings and bodies are materialized through multiple historical strata, and further, that the materializations of lay people require as much skill with objects, practices, and representation as do those of experts.

Janice L. Neri *University of California, Irvine*

The Visual Rhetoric of Insect Illustration:
Technology & Visuality in the Seventeenth Century

Seventeenth-century users of microscopes set their sights on the familiar and mundane world of very small objects—seeds, household items, bits of fabric, and especially insects. The images produced by these early microscopists present stunning views of flies, lice, termites, and other insects as they had never been seen or depicted these magnified views transform small and insignificant creatures into fascinating, strange, and wholly new beings—exotic animals. Images of insects such as those found in Hooke’s *Micrographia* or Leeuwenhoek’s studies are often cited by historians as examples of the careful and precise observation of nature characteristic of the advances in seventeenth-century science and technology. In this paper, however, I argue that such images were the product of reciprocal relationships between image-makers and observers who made use of older image-making practices that combined fantasy and imagination with precise observation. It was through the use of these two methods of visual representation—the rhetoric of the real and the rhetoric of fantasy—that early users of microscopes were able to make sense of the startling new visions they experienced. The results were images that present views of insects that are both familiar and exotic.

William Newman *Indiana University*

The Fire-Analysis Debate Before Boyle and Van Helmont

Since the 1960’s it has been known that Robert Boyle’s famous attack on the Paracelsian “tria prima” (mercury, sulfur, and salt) owed a significant debt to the Belgian iatrochemist Joan Baptista Van Helmont. In his *Ortus medicinae* of 1648, Van Helmont argues (as Boyle would later do) against the much-vaunted claim of the Paracelsians that analysis by fire provides a fool-proof demonstration of the tria prima’s pre-existence in compounds. Van Helmont points out that the Paracelsian position contains an obvious fallacy—the assumption that the disintegration of a body always reveals pre-existent ingredients rather than mere artifacts of decomposition. On the strength of this paralogism, the human body should be composed of worms, and cheese of mites. It has not been realized widely that Van Helmont himself was the beneficiary of a long and increasingly bitter scholastic debate about the pre-existence of substances in mixtures. Thomas

Erastus made the subject a *cause celebre* in the appendix to his *Disputationes de nova Philippi Paracelsi medicina* of 1572, and the topic was incorporated into Daniel Sennert's discussions of atomism, beginning in 1619. In my talk, I will focus mainly on the highly polemical Erastus, while also pointing out the ramifications of his argument for the history of atomism and the Aristotelian distinction between artificial and natural substances.

Richard J. Noakes *University of Leeds*

'Imponderables in the Balance':

Rewriting the History of Victorian Physics and Psychical Research

This paper explores the complex connections between Victorian research into evanescent physical phenomena, technology, and spiritualism. The radiometer, the electrical discharge tube, and the sensitive flame were among the most spectacular instruments of the Victorian physics laboratory. For many late-nineteenth and twentieth-century scientific commentators, these instruments also mediated phenomena that were of major importance in the 'discovery' of the electron and in the understanding of gases and radiation. This paper contends that these latter interpretations obscure some of the more striking uses to which such instruments were originally put. It focuses on the work of William Crookes, the analytical chemist who invented the radiometer, William Fletcher Barrett, a physicist and leading exhibitor of the sensitive flame apparatus, and Cromwell Varley, a telegraphic engineer whose experiments on electrical discharge were judged to have furnished decisive evidence for the corpuscular nature of cathode rays. Crookes, Varley and Barrett were also among the most eminent psychical researchers of the nineteenth century, and this paper argues that their strategies for producing evidence for spiritualistic phenomena were informed by and informed the development of the instruments for which they were celebrated. Although these strategies failed to produce conclusive evidence for spiritualistic phenomena, Crookes, Varley and Barrett successfully exploited their command of the transient phenomena displayed in their instruments to claim authority over a much wider range of transient phenomena and to defend their scientific reputation. The paper concludes by considering the implications of these historical episodes for the historiography of Victorian physics and psychical research.

Tara E. Nummedal *Stanford University*

Gender, Authority and the Alchemical Career of Anna Maria Zieglerin

In 1571, a female alchemist named Anna Maria Zieglerin arrived at the court of Duke Julius of Braunschweig-Wolfenbüttel in the Holy Roman Empire. Zieglerin herself held no official position at court and was simply accompanying

her husband, Heinrich Schombach, who had come to assist an alchemist Duke Julius had recently hired. Nonetheless, Zieglerin quickly found ample opportunity to pursue her own alchemical interests at Julius's court. She had her own laboratory in which she carried out alchemical processes, and tried to interest the Duke in her work by presenting him with a booklet on the preparation of the Philosopher's Stone in 1573. The centerpiece of Zieglerin's career in Wolfenbüttel, however, was her claim to have a special relationship with a mysterious adept in the alchemical arts, Count Carl von Oettingen. This count, Zieglerin contended, was not only Paracelsus's illegitimate son and thus had unique access to alchemy's secrets he also had shared his knowledge with her over the course of a long amorous relationship in which he came to see Zieglerin as his partner in an alchemical project of great import. As I shall argue in this paper, Zieglerin's account of her relationship with the fictional Count Carl served a twofold purpose. First, she used the story quite successfully to attract attention and establish herself as a legitimate alchemist whose knowledge and expertise surpassed even that of her male colleagues at court. Second, the story played an equally important role in Zieglerin's understanding of her personal life. By making herself out to be the fictional Count's partner in nothing less than the alchemical regeneration of the world, she gave shape and meaning to her own life story as well. Ultimately, Zieglerin stands at the conjunction of science and self in early modern Europe, suggesting that legitimating the two were often part of the very same process.

Brian W. Ogilvie *University of Massachusetts, Amherst*

The Many Books of Nature:
How Renaissance Botanists Created and Responded to Information
Overload

Formerly fact-poor, botany became a fact-rich discipline in the sixteenth century. As an unintended consequence of new attitudes and techniques in botany, the number of plants described in botanical books grew an order of magnitude between 1530 and 1630, creating new problems of organization and classification. To humanistically-oriented naturalists, this phenomenon was as much a problem of words as of things: for every new plant at least one new name was coined, often more, and these new names appeared in a burgeoning variety of new books. Indeed, it soon became difficult to tell whether a new name corresponded to a new plant or whether it was simply a synonym for something already known, and naturalists had to master an increasingly large bibliography before they could themselves decide whether they had discovered something new. The solutions that were developed for this problem of information overload were effective, but they helped transform botany from an amalgam of humanism and medicine to an autonomous discipline which no longer attracted much interest from the broader culture.

Naomi Oreskes *University of California, San Diego*

Computer Models and the Rise of Prediction in the Earth Sciences

The hypothetico-deductive models of science lead many scientists to believe that prediction is inherent in the scientific method. Yet historically, prediction has until recently played little role in the earth sciences. On the contrary, for the better part of two centuries, most earth scientists eschewed both logical and temporal prediction, viewing it as beyond the scope of their science. However, in the last two decades, the rise of computer-generated numerical simulation models has led to a radical change in thinking, and temporal predictions are becoming increasingly common as output from such models. Indeed, earth scientists now routinely attempt to predict the future. But these attempts generally meet with failure, or at best only very partial success. Why are earth scientists making predictions, if they are not generally successful? Why have they embraced temporal prediction as a goal, when previously they rejected it? This paper will examine the historical and social context of the rise of prediction in the earth sciences in the late twentieth century.

Abena Osseo-Asare *Harvard University*

Gender and Workplace in the Gold Coast

This paper will address in greater detail the processes by which African mothers, Women Medical Officers, African health workers and the colonial administration constructed health care for women and children from 1919-1934. First, I will outline the initial concern with infant mortality and its relationship to African health practices and colonial labor needs. Second, I will consider the role of European women medical officers in advocating infant health. Third, I will discuss the development of the maternity hospital at Korle Bu and midwifery education. Through all of this, I will identify how the multiple constructions of women's labor served to place the onus of the colony's prosperity on African mothers and underpaid medical officers. And finally, I would like to locate midwife training in the context of debates over the training of other medical professions. Why were colonial officials reluctant to train men as physicians or medical officers, yet willing to train women to be midwives?

Donald E. Osterbrock *Lick Observatory, University of California*

Herman Zanstra, Donald Menzel,
and the Zanstra Method of Nebular Astrophysics

"Zanstra's method," a simple but powerful method of measuring the temperature of a hot photoionizing star in a gaseous nebula, was worked out in the early days

of quantum mechanics by Herman Zanstra, a young Dutch theorist with a Minnesota Ph.D.. The central ideas behind it were suggested to him by Walter Baade, the outstanding observational astrophysicist then at Hamburg-Bergedorf Observatory in Germany. Zanstra first gave an oral paper on his method at an American Physical Society meeting at Stanford University in 1926, just before Donald H. Menzel arrived at nearby Lick Observatory to take up a research position. Menzel had been Henry Norris Russell's star graduate student at Princeton, where he earned his Ph.D. in 1924. Menzel published an excellent, short, critical review of nebular astrophysics soon after he arrived at Mount Hamilton. Zanstra published the full theoretical treatment of his method in 1927, and in 1928 published results he obtained with it using the 72-in reflector of the Dominion Astrophysical Observatory, Victoria, BC In this period he was at Caltech and then at the University of Washington. However, beginning in 1931, Menzel frequently claimed that he and Zanstra had invented the method independently and nearly simultaneously, and that it should therefore be called the "Menzel-Zanstra" method. This was not correct; the paper he cited for his claim was his 1926 review, which did not give a physical basis for the method, and in fact further concluded that it did not work. His review had therefore stated that fast particles rather than ionizing photons were probably the mechanism at work in the nebulae. Several possible reasons for Menzel's incorrect will be discussed.

Eric J. Palmer *Allegheny College*

A Philosophical Education Program:
Descartes Selon l'ordre des Recitations

Those who have control of the youth of a generation stand to have their ideas diffused broadly as that generation moves through adulthood. Descartes freely admits the goal of promoting his new philosophy for the purpose of educating the elite of coming generations. He famously solicited the Sorbonne for approval of his approach in the preface to the *Meditations*, and he went on to write a textbook suitable for educating the youth at university. Those strategies did not work: the Sorbonne initially ignored him, and the Jesuits, responsible for lower education, swiftly attacked him on theological grounds. So on what roots could Cartesianism have grown in France during the second half of the 17th century? Though it should be unsurprising that Descartes' success connects intimately with that of Nicholas Malebranche of the *Oratoire Francaise*, no adequate account of the general popularity of Descartes' system has yet been offered. The Oratoire de France, an activist Catholic order begun in Paris in 1611, was granted the right to set up schools, beginning in the 1620's. Whereas Jesuit schools continued to stress metaphysics, the Oratoriens also distinguished themselves by turning their new curriculum further toward mathematics and natural philosophy, which were subjects especially consonant with Cartesian philosophy. Thus, I suggest, Descartes used the *Oratoire* to forward scholarship

and to promote an educational program that was rejected by the Jesuits. The Oratoire, in their turn, used Descartes and Cartesianism to fortify their scholarship and distinguish their new schools from those of the Jesuits.

JoAnn Palmeri *Independent Scholar*

Sagan and Shapley:

The Astronomer as Prophet of Science in the Twentieth Century

The striking parallels between Carl Sagan and Harlow Shapley are explored in this comparative account of the public careers of these two prominent twentieth-century astronomers and science popularizers. The fact that studies of the origin, nature and fate of the universe are for most people connected to fundamental questions of spiritual and philosophical significance has assured the continuing mass appeal of astronomical and cosmological inquiry. Two of the most widely read popularizers of the early part of century, Eddington and Jeans, incorporated spiritual and philosophical perspectives in their popular accounts of the universe. In the late twentieth century, the merging of astronomical and evolutionary perspectives has made the cosmic landscape that much more compelling as an arena for scientists and laymen alike. Perhaps the most well-known proponent of evolution on a cosmic level was Carl Sagan, the planetary scientist and astronomer who gained worldwide fame in the 1980s with his popularization efforts, including his most well-known opus, the television series *Cosmos*. With humanity's place and ultimate fate at issue, the cosmos has become a forum for exploring questions of enduring significance, a nexus for public conversation on the issue of the relationship of science and religion as well as the question of the relevance of science for contemporary society. In the process, scientists like Sagan have helped to shape the role of the astronomer as prophet of science. As an astronomer with strong biological inclinations, one who popularized the issue of the life in the universe, characterized humans as "star stuff," presented science as a kind of revealed religion, sought cooperation with the Soviet Union as a means to preserve civilization, and presented his message to viewers of the popular television program *The Tonight Show*, Shapley's story serves as an intriguing prelude and comparative case for the subsequent activities of Sagan.

David A. Pantalony *University of Toronto, Institute for the History and Philosophy of Science and Technology*

Bringing Sound Into the Laboratory:
The Visual Analysis of Compound Tones

The publication of "Die Lehre von den Tonempfindungen" (On the Sensations of Tone) by Hermann von Helmholtz (1821-1894) in 1863 inspired the growth

of experimental acoustics across Europe and North America, resulting in a proliferation of novel instruments for studying sound. The Klang (Sound) Analyzer, made by Rudolf Koenig (1832-1901), demonstrated one of Helmholtz' finest achievements, the theory of sound quality, or *Klangfarbe*. Koenig, who had played a major role in developing the Helmholtz resonator into an instrument of "precision and certainty," first introduced the Analyser in 1865. It was part of a family of instruments deriving from a new optical method invented by Koenig in 1862, the manometric flame technique. In this talk, I describe how the Analyser developed, what it was used for, early praises and critiques of its performance, a later adaptation by Max Kohl, and how it actually worked in the classroom and laboratory. Such a common, yet complex instrument provides a rich perspective on the practice of acoustics in the nineteenth century. Much of this research stems from the examination and operation of Koenig's instruments at the University of Toronto and the Smithsonian Institution, Washington D.C. In particular, I focus on the Sound Analyser, now at Toronto, that Koenig demonstrated at the 1876 exhibition of Philadelphia.

John L. Parascandola *U.S. Public Health Service*

Science and Sex:

The Venereal Disease Education Campaign of the U.S. Public Health Service in World War II

In a speech delivered in January, 1999, Surgeon General David Satcher indicated that while generals and admirals in the military rely on ships or aircraft or troops as their source of power, the Surgeon General of the Public Health Service (PHS) "relies on science—the best available science—to manage and advance the nation's health." It has not always been easy, however, to establish public health policies on the basis of scientific knowledge alone, without the intervention of social, political, and economic considerations. This paper attempts to illuminate this point by examining the difficulties encountered by the PHS and Surgeon General Thomas Parran in balancing medical and moral concerns in the Service's VD education campaign during the Second World War. In a scenario that resembles in many ways the reaction to the AIDS epidemic of the 1980s, Parran and the PHS were criticized in some quarters for being too explicit about sexual matters and for promoting prophylactic measures in the educational materials produced and distributed by the Service. While Parran was sensitive to moral and religious concerns, he believed that health agencies were responsible for dealing with venereal diseases as dangerous contagions and not for the teaching of sexual morality. He noted that with the aid of available scientific methods it should be possible to eliminate venereal disease in his generation's lifetime, a timetable that "may be well in advance of any major changes in the sex habits of the population as a whole." Science, however, sometimes had to bow to social and political

pressures, as for example when the PHS withdrew as the national distributor of one venereal disease education film in the face of opposition from the Catholic Legion of Decency.

Philip J. Pauly *Rutgers University*

Fighting the Hessian Fly: Ecology and Diplomacy in a Time of Revolution

In the early 1780s a new wheat pest appeared in New York and New Jersey. Soon named the “Hessian fly” by Revolutionary War veteran and American Philosophical Society member George Morgan, it engaged the attention of American leaders interested in maintaining agricultural prosperity, building science, and promoting what Morgan called “a useful National Prejudice” against the forces that had been brought to America by George III. The insect became a source of real tension between the United States and Great Britain in 1788, when the Privy Council, on the advice of Royal Society president Joseph Banks, used it to justify a ban on the importation of American wheat. Debates over the origin, range, and behavior of the Hessian fly illuminate science-based understandings of human-mediated biological invasions, as well as the bases for prudential official judgments about invasion risks, prevalent in the late 18th century. The episode also provides a concrete example of the practical problems involved in insect species identification immediately after Linnaeus. Finally, the sudden end to diplomatic concern over the Hessian fly in late 1789 demonstrates the nesting of disputes about biological invasions within the wider framework of “political ecology.” Famine and the French Revolution induced British leaders to reassess the risks and benefits of cheap American wheat; the immediate danger posed by the potentially riotous human population of England was more compelling to them than the imagined consequences of an invasion by the Hessian fly.

Denise Phillips *Harvard University*

Citizenship and Science:

German Civic Scientific Societies and the Revolutions of 1830 and 1848

In the first half of the 19th century, Germany’s civic voluntary associations formed the organizational bedrock of both political liberalism and middle class public life. Over the same period, voluntary associations also became central to the pursuit of natural science. By 1850, every German town of any size or importance had its own local natural scientific society these associations provided an important intellectual forum for both eminent scholars and obscure local notables. Local societies joined together everyone who laid claim to the title ‘natural scientist’ in this period. This group included university professors,

but also scientifically minded state bureaucrats, doctors, ministers and businessmen. Like other kinds of voluntary associations, scientific societies presented a potential challenge to state authority. In claiming the right to speak for the general good, they moved into a position that had previously been occupied by the state alone. Governed by constitutions and ruled by elected officers, these societies presented in microcosm the principles that early 19th century liberals hoped to realize in the polity as a whole. This paper will examine the role of scientific associations in the liberal revolutions of 1830 and 1848, analyzing the place of civic natural scientific activity in relation to other projects that aimed to reconfigure political authority in this period.

Wade E. Pickren *American Psychological Association*

Life and the “Age of Psychology”:
The Public Image of Psychology in the 1950s

The rapid growth of psychology after World War II brought unanticipated benefits and problems to organized psychology. The benefits included a sharp increase in membership in the leading psychological organization, the American Psychological Association (APA), and a concomitant rise in the knowledge base of psychology. Changes in American society contributed to the growth of the practice of psychology through an increased demand for psychotherapy and other mental health services. The increased salience of psychology in the public eye was not an unmixed blessing to professional psychologists. The problematic relationship of psychology and the public is examined through the lens of the series on psychology that ran in *Life* magazine during the middle years of the 1950s. At the time of their publication, it was estimated that the *Life* series increased public awareness of psychological concepts more than any other publication ever had. The articles in the series are examined in the light of archival correspondence between the series editor for *Life*, Ernest Haveman, and Michael Amrine, public information officer for the American Psychological Association. This episode is discussed in terms of how the psychological imagination of the American public was shaped in the middle years of the twentieth century.

Chris Pires *University of Wisconsin*

Power of the Unified Narrative:
Placing Botany in the Evolutionary Synthesis

The traditional Evolutionary Synthesis narrative, as told by zoologist/historian Ernst Mayr, characterizes a transformation in twentieth century biology from diverse efforts performed by fragmented subdisciplines to a unified effort that

was led by “architects” of the Synthesis. The designated botanist of the Synthesis, G. Ledyard Stebbins, agreed with Mayr that Botany was “delayed in entering the Synthesis” in comparison to zoology and paleontology. However, when one looks at the kind of work being done in botany during the 1930s and 1940s, it becomes clear why many botanists did not accept major tenets of the Synthesis narrative—even as revised by Stebbins. Botanists had to decide whether to keep their more pluralistic understanding of species and speciation, or sacrifice some of their concepts to join the newly forming field of evolutionary biology. Much of the history of this period reflects botany as it was contextualized by Mayr, Stebbins and others, thus missing the “voice” and culture of botanical activity that did not fit into the dominant Synthesis stories. In order to analyze the impact of Mayr’s and Stebbins’ narratives, I examine three prominent botanists who did not readily join in what many see as one of the greatest intellectual achievements of the twentieth century: Jens Clausen, David Keck, and William Hiesey. Although much of their perspective is lost in the Evolutionary Synthesis narrative, Clausen, Keck, and Hiesey laid much of the foundation for plant researchers in the latter half of this century.

Hans Pols *University of New Hampshire*

Teaching Adjustment:

Undergraduate Psychology Courses in Human Development, 1920-1960

In the 1930s, courses called “Mental Hygiene,” “Human Adjustment,” or “The Psychology of Personality” courses were taught at virtually all colleges where they became the very first course in psychology any student would take. These courses focused on aiding students in maintaining and enhancing their own mental health. A whole textbook market was geared to provide appropriate readings for them. Authors of such books expressed the view that, following the ideals of a liberal arts education, colleges did not only need to impart knowledge but also needed to form the characters and personalities of the students in their charge. Since psychology was the science of human nature, these psychologists thought that they were the most suitable teachers of these courses. In this paper I contend that these courses in psychology both presented the latest results of psychological investigation and culturally, ethnically, and class-specific views of how individuals should lead their lives and how they should resolve problems they encountered. In the 1920s and 1930s, these courses emphasized the importance of habit training and regularity. In the post-World-War II years, their focus changed to an interest in emotional dynamics. In the 1950s, a third type of textbook appeared, presenting an overview of results of psychological research relevant to mental health, leaving it to the student to apply these to practical situations. In the 1950s, when the discipline of psychology grew exponentially, the opposition among psychologists against these courses grew. Many scientifically-oriented

psychologists claimed that science, rather than emotional guidance, should be the focus of undergraduate courses in psychology. As a consequence of a reorientation of the discipline towards furthering the science of psychology, human adjustment courses disappeared. In this paper, I will analyze these human adjustment courses in the way they present psychology to an undergraduate audience, what elements from psychology they emphasize, and I will provide a background of the authors of these books. These courses are important for several reasons. First, psychologists teaching human adjustment courses were concerned with formulating modern standards of behavior and in this way often reified cultural norms and expectation. In other words, these courses naturalized specific cultural norms and expectations as the outcome of psychological research. Second, these courses were a very influential vehicle for the popularization of psychology. As a consequence, the demand for clinical services might increase. However, the cultural influence of these courses has been much more pervasive, since they succeeded in familiarizing several generations with basic psychological insights.

Marcus Popplow *University of Bremen / Max Planck Institute for the History of Science*

The Role of Engineer Drawings in the Emergence of Classical Mechanics

In the realm of practical mechanics in the 15th and 16th centuries, different kinds of engineer drawings rather than theoretical texts were widely used to consider mechanical phenomena. Well-known figures of pre-classical mechanics from Tartaglia to Galileo were familiar with this medium of relection. At the same time, the engineer drawings of this age give evidence of rules of thumb employed by practitioners which reveal, at least partly, their understanding of the relationship of force, time and space. This paper presents an overview of both these aspects of the emergence of classical mechanics.

Theodore M. Porter *University of California, Los Angeles*

Project for a History of Social Science, 1750-1890

Social science is generally represented as very young, yet the disciplinary histories often go back to Aristotle. Perhaps because history remains more important for social science than for most of the natural sciences, its goals and styles continue to be set by practitioners. Here I ask how the social sciences should be understood by history, and how it would alter our writing about their history. One crucial point is that the modern disciplines had a very tenuous existence in social science before about 1890. This pertains to the organization of knowledge, and the practices by which it was generated, as well as to the social structure of disciplines. Here I set out

to define some topics and problems that subvert or cut across disciplinary divides, and that point to shared aspects of their cultural and intellectual identities. One of these is the use of quantification, which has been a lively topic within history of science in recent decades. Another is the practices and discourses of laboratories and interventions. I would gather both of these issues under a large rubric, the rival forms of experience in nineteenth-century social science. Should experience be direct or vicarious, broadly interpretive or reduced to forms and tables, gathered up individualistically or bureaucratically, ethnographic or statistical? What social backgrounds and educations provided preparation and standing to study social science in these various ways? A second large issue is the relation of social to natural science. It would be a mistake to suppose that this was entirely or even mainly a relationship of one-way dependence, though it was common already in the late eighteenth century to represent it this way. The choice of natural-scientific models was of course an important one: botany, morphology, and mathematical physics had very different implications for social understanding. To this we should add that in no case were the implications self-evident. One of the main tasks of philosophy of science throughout this period was to clarify that relationship. Finally, I will emphasize that social science represented not only an ideal of knowledge, but also of management and reform. That has remained true into the more contemporary period, but is unmistakable for the earlier one. Again, this points us not to a monolithic explanation, but to a set of alternatives. Among the most important was the choice between social science as a contributor to a broader public discussion—social science in the public sphere—and a more recondite social science aimed mainly at expert bureaucracies. The politics, moreover, was very much contested, in relation to class, gender, political affiliations, and geographic situations.

Patricia M. Princehouse *Harvard University*

Mutant Phoenix: Macroevolution from Germany to the U.S.

Julian Huxley declared that the Modern Synthesis was Darwinism “risen from the ashes of the pyre like a mutated phoenix” thanks to those following the “true-blue Darwinian stream.” Huxley and other Modern Synthesis writers were actively constructing an ontological essence for Darwinism. This rhetorical move succeeded in privileging a set of rules that largely excluded many of the instrumental and methodological traditions in which evolutionists of the time were invested, even though they were all working within the same basic paradigm. But the Modern Synthesis program was not the only possible incarnation of the mythical synthesis animal. Due to the dislocations of the war, and institutional structure of their science departments, German paleontologists, most notably Otto Heinrich Schindewolf, constructed an alternative synthesis, derived in part from Goldschmidt’s field studies and lab genetics. This was much more synthetic and holistic than the Anglo-American Modern Synthesis, significantly incorporating data and approaches from

genetics, embryology, cytogenetics, botany, ecology, paleontology, sedimentology, and other fields. Although it did not claim the mantle, it was in many ways more in the spirit of Darwin than the neo-darwinians were. Schindewolf's student, Adolf Seilacher, was driven to the study of evolution in part by experiencing radical contingency first-hand as a German soldier in WWII. The grand narrative constituting his theory of history was shattered. In a move reminiscent of the annales school, Seilacher investigated the quotidian existence of worms, slugs, and other critters in the economy of nature via the fossilized evidence of their tracks, trails, burrows, and death scenes to produce a narrative of contingency, physical and developmental constraint, and spectacular adaptation to local environments. In the 60's and 70's, young American paleontologists (Raup, Eldredge, Gould, Stanley, inter alia) drew on this German synthesis when they challenged the explanatory adequacy of the "hardened" Modern Synthesis and the hegemony of population genetics, to reassert macroevolution as a source of theory.

Robert N. Proctor *Pennsylvania State University*

When did Humans become Human? The Impact of Racial Liberalism on the Recognition (and Denial) of Fossil Hominid Diversity 1944-2000

New fossil finds have revolutionized the understanding of fossil hominid phyletic diversity in recent decades. Today, there is fairly wide acceptance of the "bushiness" of the human ancestral tree—circa 10-20 different hominid species in 3 separate genera over the past million years—though that "consensus" was not established without a struggle. Recognition of fossil hominid diversity was hampered by post-WWII conceptions of racial diversity, especially the New Synthesis celebration of (intra-species) genetic variability, but also the related liberal anti-racialist consensus that culminated in the UNESCO Statement on Race. I will explore the impact of post-Auschwitz racialist ideologies on conceptions of hominid diversity, focussing especially on the so-called "single hominid hypothesis"—the idea put forward by Dobzhansky, Mayr, Simpson, Brace, and others that only one hominid species could ever exist at any given time in paleontologic history. The idea was partly that genetic diversity was sufficient to embrace any and all hominids as "human," there was also the idea that the human cultural "niche" was too tight to allow more than one occupying species. Morphologists contributed to the myopia, with the idea that there simply wasn't enough "morphologic space" between *A. africanus* and *H. erectus* to shoehorn in another species. I plan to trace the rise and fall of the single hominid hypothesis from the period 1920-1950, when taxonomic diversity implied racial differentiation, to the period 1950-1970, when hominid diversity was shunned in the wake of the UNESCO Statement, to the period 1970-1990, when diversity again came back into fashion, albeit now without the racialist overtones that had colored much of

earlier morphologic thought. I will also say something about the impact of these transformations on the thesis of human recency—the idea that pre-sapiens hominids were not “human” in some deep and interesting sense. Some comments will also be made about the stability of the Acheulean and its relevance to the thesis of human recency.

Karen A. Rader *Sarah Lawrence College*

Teaching “Science and Film:”
Visual Representation as a Pedagogical Window
on Artistic and Scientific Practice

This paper will draw on the author’s experience teaching a course devoted exclusively to “Science and Film”. Many history of science scholars have successfully incorporated film into their teaching of topical courses. But few have explored the history of film itself as a topic that enables exploration of a broader set of issues related to the political and cultural meanings of visual representation, both in science and society-at-large. These issues include: how technological advances in film (still photography and motion pictures) have contributed to new understandings of scientific knowledge why film has been such a potent resource for shaping public understandings of the scientific enterprise and ultimately, what have been, are, and could be the relations between science and art as cultural activities. Specific pedagogical strategies for addressing such themes will be discussed, along with suggestions for how to encourage students to incorporate their study of these themes practically across the often-competing curriculums of science and creative arts.

Peter J. Ramberg *Max Planck Institute for the History of Science*

Making Instruments “Transparent” in Organic Chemistry:
The Case of Halogen Addition Reactions

In presenting the experimental results in support of the new principles of stereochemistry, the organic chemist Johannes Wislicenus (1835-1902) entered disputes with both Rudolf Fittig (1835-1910) and Arthur Michael (1853-1942) about the correct reaction conditions for the addition of halogens to multiple bonds. Whereas Fittig and Michael disagreed with Wislicenus for different reasons, both accused Wislicenus of performing chemical reactions under the wrong external conditions. Wislicenus returned this accusation, claiming that it was Michael and Fittig who executed these reactions under “abnormal” conditions. In this paper, I will briefly recount this episode and its eventual resolution, and explore the parallels between this story and several recently published case studies treating the historical processes behind giving authority

to a scientific instrument such as Newton's prisms or Boyle's air pump. The story of Wislicenus, Fittig and Michael, in which the authority of no instrument in a conventional sense was at stake, suggests a reconsideration of the nature of instruments in chemistry, and the limitations on the historiographical assumptions behind the concept of making instruments "transparent."

Nicolas Rasmussen

Steroids at War:

Biomedical Researchers, the Pharmaceutical Industry,
and the Hormones of the Adrenal Cortex, 1940-1946

It is widely considered that the Second World War marks a discontinuity for both physical and life sciences, in that large numbers of basic researchers were brought together in well-funded government research projects for the accomplishment of practical military goals, initiating a transition to the postwar era of 'big science'. This paper discusses wartime research on the cortical hormones, one of the largest of both the OSRD Committee on Medical Research and Committee on Chemistry, which despite failure to meet its wartime goals led to the postwar introduction of the archetypal miracle-drug cortisone. Analysis of the sharing of information and division of labor both within the basic life science research community, and between biomedical research institutions and commercial contractors, points instead to a continuity of the manner of life scientist-industrialist relations throughout the war period. This finding suggests that the degree to which many areas of life science in the interwar period were already organized on a large scale and oriented toward industrial application has been generally underestimated.

Benjamin W. Redekop *Kettering University*

Thomas Reid and the Problem of Induction:
From Common Experience to Common Sense

In this paper I argue that in responding to the "problem of induction" as advanced by David Hume, the influential eighteenth-century Scottish philosopher Thomas Reid reformulated Aristotelian foundationalism in distinctly modern terms. An educator and mathematician self-consciously working within the framework of the new science, Reid articulated a philosophical foundation for natural knowledge anchored in the human constitution and in processes of adjudication in an emerging modern public sphere of enlightened discourse. In the process Reid transformed one of the traditional foundations of Aristotelian science—common experience—into a philosophically and socially justified notion of "common sense." The new

science had challenged the primacy of common experience in favor of recondite, expert, and even counter-intuitive knowledge increasingly mediated by specialized instruments. Meanwhile modern philosophy had also problematized the perceptions of common experience—in the case of Hume this included our perception of causality itself, a fundamental precondition of scientific endeavor. I argue that these challenges to the traditional foundations of the scientific enterprise, along with the rise of “middling” classes and a modern public sphere, the concurrent rise of public science, and the belief that scientific knowledge was crucial to social advancement and development, lay behind Reid’s reintegration of scientific knowledge and common experience, albeit now explicitly and in “scientific” terms. The paper draws on recent work by historians and sociologists of science (including among others Peter Dear, Lorraine Daston, Steven Shapin, Larry Stewart, Jan Golinski, and Mary Poovey), as well as on the literature of the modern public sphere stimulated by Habermas. It is grounded in a close reading of Reid’s published texts and in extensive archival research in Reid’s personal papers, and in the primary and secondary literature of the Scottish Enlightenment.

Eileen Reeves *Princeton University*

Galileo and the Reflecting Telescope: Some Speculation

The particulars of Galileo Galilei’s several and conflicting accounts of his development of the Dutch telescope have often been treated with skepticism: the timing of the events of spring 1609, his optical expertise, the technical information relayed to the scientist by Jacques Badovere, and the degree of unacknowledged collaboration have all been subject to special scrutiny. What has been left unexamined, however, is the proposition that what Galileo and his informant Paolo Sarpi first understood by the earliest reports of a spyglass developed in The Hague actually bore great resemblance to the Dutch or refracting telescope. This paper will argue that Galileo was, like Sarpi, aware of news of the spyglass from late 1608, that their original impression of the instrument may have been something much closer to a primitive reflecting telescope, and that what Galileo portrayed as his relatively tardy acquaintance with the rumor from The Hague is better explained as a brief period in which he worked fruitlessly to refine the wrong technology. There are several reasons to suppose that Galileo and Sarpi would have associated telescopic properties with mirrors, or mirrors and glass lenses, rather than with glass lenses alone. Both men had done some research in catoptrics in the prior decades, the importance of which has recently been demonstrated by Sven Dupre. Moreover, in the same month in which he encountered the report of the Dutch telescope, Sarpi also read an account of a mirror with telescopic properties in the possession of Henri IV significantly, its alleged developer was in close contact with Jacques Badovere. Finally, because the motif of a telescopic mirror upon

which the fortunes of an empire depended appeared quite commonly in European literature of the twelfth, thirteenth, and fourteenth centuries, the apparent invention of just such an instrument in 1608 would have filled a preexistent and familiar cultural fantasy.

Joan L. Richards *Brown University*

Sophia and Augustus De Morgan's Faiths of Mind

In 1863, the London house of Longman, Green, Longman, published *From Matter to Spirit* by "CD" with a Preface by "AB," with the mathematical symbolism in ironic contrast with the spiritualist convictions in the book. Behind the AB stood Augustus De Morgan, the distinguished professor of mathematics at University College, London; behind the CD stood his wife, the socially active mother of their seven children. Augustus's "Preface" served as a defense of the intellectual legitimacy of his wife's report on a decade of investigation into the mid-Victorian world of channeling mediums, turning tables, and writing spirits. Augustus was unequivocal in his conviction about the events and experiments Sophia reported in her book: "I am perfectly convinced that I have both seen and heard in a manner which should make unbelief impossible, things called spiritual . . ." (v) Even as Augustus defended the legitimacy of his wife's experiences, however, he distanced himself from them, saying he would not "stand committed either for or against the conclusions of the book." (v) Augustus's ambivalent support for Sophia's work can be seen as an attempt to defend his reputation as a cool-headed scholar even as he used that reputation to protect his wife's investigations. But it was more than that. Sophia's book contained an interpretation of those incidents built on a view of language and truth diametrically opposed to the logical one he had been developing and defending for years. Augustus did not address his and Sophia's differences directly in his preface, but at its end he did recognize them with the comment: "Between us we have, in a certain way, cleared the dish; like that celebrated couple of whom one could eat no fat and the other no lean." (xlv) *From Matter to Spirit* appeared at the very beginning, if not before, the period in which Victorians and their historians have located the Victorian crisis of faith. What is more, neither Augustus nor Sophia would have claimed allegiance to the kind of religious faith that would support crises among their more orthodox compatriots. Nevertheless, the tension between the ways that they assigned meaning to words and events mirrors that which many of their somewhat younger compatriots faced within themselves. The Victorian crisis of faith is often interpreted as the product of an epistemological crisis. In this paper I want to use *From Matter to Spirit* to reconsider that crisis from the perspective of meaning as opposed to epistemology, to consider what supported Sophia's and Augustus's complementary worlds, and to explore what made their coexistence so difficult in the next generation.



Robert J. Richards *The University of Chicago*

Why Haeckel Became a Virulent Darwinian

The historical antagonism between Darwinian theorists and the religiously minded has many sources, but Ernst Haeckel's virulently anti-religious stance, which became part of his many books and articles directed to the promotion of Darwinism, must be regarded as a primary cause. But why did Haeckel assume such a strident posture, a posture which not only antagonized religious believers but fellow scientists as well? He might have argued—as he initially did at the meeting of the Association of German Naturalist and Physicians in 1863—that God first breathed life into an original form, and natural processes produced the variety of life we now observe. Haeckel first wrote Darwin after the meeting, and received a very warm reception from the English scientist. But a short time later an event occurred that altered everything. After this event, Haeckel elevated his scientific convictions into a quasi-religious passion. In a white heat he composed his *Generelle Morphologie der Organismen*, a two-volume exposition and defense of Darwinism that was written in vitriol. The battle against the forces of superstition and misery was joined, and the resulting antagonism has hardly abated even today.

Alan W. Richardson *University of British Columbia*

The Insecure Path of a Science:
Kant and the Rethinking of Logic in the 19th Century

Immanuel Kant was able to motivate his epistemological project by relying on the status of particular disciplines as *a priori*. Among these disciplines, logic was distinguished by both its age and its completion. Aristotle's logic had in all essentials completed the task of codifying the rules of judgment and inference and had provided the "canon of reason." Shortly after Kant, however, mathematicians, scientists, and philosophers began seriously to rethink both the theory and the subject matter of logic. Some (Boole, Grassmann, Schroeder) wanted to convert it into a mathematical discipline investigating the algebra of thought. Others (Herbart, Bolzano) wanted to rethink the objects appropriately understood to be the subject matter of logic while yet others (Fries, Mill) sought in various ways to tie logic to an increasingly empirical study of the human mind. This talk seeks to explore the ways in which logic strayed from "the secure path of a science" (*Critique of Pure Reason*, Bvii) by looking to Kant's work itself as the primary locus of the destabilization of the understanding of logic that Kant himself took for granted. The paper proceeds by exploring a number of ways in which the "formal" nature of logic might be understood after Kant.

Marsha L. Richmond *Wayne State University*

Cell Theory on the Eve of Genetics

A cardinal event in the early history of genetics was the recognition circa 1904 that the behaviour of the chromosomes during the process of replication closely paralleled that expected of Mendelizing factors. Thus was founded the new subdiscipline of cytogenetics, which mutually enriched classical genetics and cytology. Yet for decades many biologists had accepted the idea that the nucleus was the seat of heredity and development. Indeed, by 1900 Richard Hertwig and his school at Munich were experimentally investigating the nature of this control. In addition to Theodor Boveri and Richard Goldschmidt, the young British zoologists Geoffrey Watkins Smith of Oxford and C. Clifford Dobell of Cambridge went to Munich to study with Hertwig. Yet while Smith accepted the nucleocentric model of the cell, Dobell subsequently became a vocal critic. This paper will assess the status of cell theory on the eve of genetics by comparing and contrasting the views of Goldschmidt, Dobell, and Smith. It explores the extent to which an individual's view of the organization of life influences their understanding of "cellular reality."

Michael F. Robinson *University of Wisconsin, Madison*

Chicago's Eskimo Village:
Reconsidering Race at the World's Columbian Exposition, 1893

In 1893, over two dozen Innu villagers from Labrador settled into their new home on the grounds of the World's Columbian Exposition in Chicago. They took their place among a variety of transplanted "savage" and "semi-barbarous" peoples who constituted the anthropology exhibits of the fair. Organizers set the Eskimo Village on the main Exposition grounds, apart from other ethnic villages on the Midway, and at a distance from the "White City," the fair's shrine to Anglo-Saxon progress. In so doing, they used the fairgrounds to represent a theory of cultural evolution still widespread within the anthropological community. Within this theory, the Eskimo Village symbolized human culture at its most primitive and offered white Americans a glimpse of their own prehistoric past. Recent studies have made use of the racial symbolism of the Columbian Exposition in interpreting professional and popular discourse about race in late nineteenth century America. Yet few studies have looked beyond the planning and production of the fair's exhibitions to the agency of native participants themselves. This paper examines the actions of the Innu within the Eskimo Village and their effect upon popular discourse. It argues that the Innu frequently acted in ways which undermined the "script" presented by anthropologists and organizers, and suggests revisions to the historiography of race at the Columbian Exposition.

Dorothy Ross *Johns Hopkins University*

The Social Science Disciplines in Europe and the U.S.:
Enlarging the Historical Lens

This paper attempts a critical overview of the development of the disciplines that are variously denominated “human,” “social,” and “behavioral” sciences, from their formation in the late nineteenth century to the present in Europe and the United States. I will focus on a number of key issues in that history and its historiography: the notion of social science disciplinary formation as a “project” the disputed location of the social sciences between science and the humanities the interplay of national and cross-national influences the construction of the social sciences as engineering sciences, particularly in the U.S. the postwar, international renewal of the social science disciplinary project and its threatened disintegration since 1970.

Michael Ruse *University of Guelph*

Was neo-Darwinism Darwinian?

The most influential idea in twentieth century American evolutionary biology was Sewall Wright’s metaphor of an adaptive landscape. I argue that, apart from being completely confused conceptually and having absolutely no basis in empirical reality, this was a deeply non-Darwinian notion that appealed because it could be used by those (the vast majority of evolutionists) who had no mathematical ability. The metaphor’s roots lie in the work of Herbert Spencer, which is no surprise for Spencer always had (and in many respects still has) far more influence on American thought than anything penned by Charles Darwin.

Steven W. Ruskin *University of Notre Dame*

Private Science , Public Imagination, and the Ambitions of Empire:
Perceptions of John Herschel’s Cape Voyage, 1833-1838

John Herschel’s voyage to the Cape Colony (1833-38) was an event of considerable interest for Britain. John sailed to the southern tip of Africa to observe the southern heavens. His intention was that the voyage be a “private affair . . . a mere party of pleasure.” But his scientific renown encouraged the public imagination to place his journey in the same category as other imperial expeditions: for example, that undertaken by Captain James Cook and Joseph Banks, and those in Africa of Mungo Park and Richard Lander. Herschel, however, did not see his voyage in this way he rejected government aid and any official status. Yet the image of Herschel as an imperial scientist-explorer remained and his voyage was popularly

appropriated as such. In this paper I shall discuss Herschel's Cape voyage from the private, public and imperial perspectives. The private perspective is that of Herschel. I intend to discuss his efforts to ensure that the voyage and astronomical observations were free from any official obligation. The public image of the Cape voyage will be discussed to help locate the voyage in the popular discourse of imperial science and exploration. By leaving the metropolis for the periphery, in the public mind Herschel also crossed the boundary from mere scientist to the much more evocative and noble position of scientist-explorer. Finally, I will consider the voyage from the perspective of the British empire, specifically the Admiralty. I shall argue that Herschel's presence at the Cape was to be used as a stabilizing factor and form of justification for British control there. Although John quite emphatically went to the Cape colony as a private citizen of private means and private intentions, his voyage was interpreted as a project aligned with and beneficial to the expansionist ambitions of the British empire.

Lisa T. Sarasohn *Oregon State University*

Samuel Sorbière: Amateur and Broker of Science

Samuel Sorbière has not fared well in the annals of the Scientific Revolution. Although Sorbière oversaw the publication of works by both Hobbes and Gassendi, and attended the Montmor Academy and visited the Royal Society, he is characterized in the seventeenth century —and now— as someone out for the main chance. Nevertheless, I will argue that his role in the emerging scientific community needs to be recharacterized. Sorbière served a specific function in the intellectual world of his day: rather than a figure living off the ideas of others, he was a true broker of knowledge. Within the social constellations of the nascent scientific community, a broker was both audience and promoter, someone who urged the development of ideas, and then served as their apostle. While serving the interests of Hobbes, Gassendi, or others, Sorbière was recognizing their status and honoring their activities. His role as broker helped actualize their role as scientists. Sorbière's activities demonstrate that the role of amateurs of science was more complex and significant than previously recognized.

Sara Schechner *Harvard University*

The Material Culture of Astronomy in Daily Life:
Sundials, Science, and Social Change

Sundials were among the most ancient of astronomical instruments, and they employed mathematical projections of surprising sophistication. By showing changing shadow lengths and positions, sundials marked the passage of time,

the recurring seasons, and the apparent motion of the sun in the sky. Sundials were also social tools. Since Hellenistic times, they coordinated people's meal times, and with the rise of monasticism, they also coordinated religious devotion. During the 14th to 17th centuries, as feudal society built on the rhythms of the countryside gave way to more urban, commercial society, time became a precious commodity to be budgeted and spent wisely. Merchant time was not the cyclical flow familiar to farmers, friars, and astronomers, but money slipping through the fingers. With the new time pressures came new images of Time. Classically portrayed as a winged youth holding a sundial, Time came to be seen in the Renaissance as a ruthless old man, an inescapable force causing ruin and decay. Sundials reflected these different (cyclical vs. linear) attitudes toward time. As time pressures became keenly felt by all members of society, the production of sundials increased dramatically in Europe. Many new types of pocket sundials kept busy people on schedule. Variations in the mathematical forms and designs also reveal how people spent their time and what they valued most. The strength and originality of this paper are its primary sources. It takes as its foundation over 2000 historic sundials preserved in museums worldwide. Although literary evidence is useful, it is only by the close inspection and comparison of many dials from different places and periods that one can build a picture of astronomy and mathematics in daily life, time discipline, and consumer culture.

Londa Schiebinger *Pennsylvania State University*

Gender in the Voyages of Scientific Discovery

The past several years have witnessed renewed interest in 17th- and 18th-century botany, the "big science" of early modern Europe. Historians have begun to analyze the importance of plants for the economic expansion of the major western European states in this period, and to explore the role of botany in European colonial expansion. This paper explores how gender relations in Europe guided naturalists as they explored other lands, peoples, and their knowledges. For over one hundred years the French, for example, sent specimens from colonial gardens in the Antilles to botanists working at the distinguish Parisian Jardin du Roi. The British furnished the elaborate Kew Gardens with dried and living specimens and exotic seeds from their extensive system of gardens stretching from Saint Vincent in the West Indies to Calcutta, Sydney, and Penang off the west coast of the Malay peninsula. How did gender mold what was included or not included in these shipments?

Londa Schiebinger *Pennsylvania State University*

Approaches to Teaching Gender in Science

I will distribute and discuss my syllabus on gender in science and also discuss the new “Women, Gender and the History of Science Syllabus Sampler” kindly collected and prepared by Andrea Rusnock. One point I would like to raise is how to attract more men into gender in science classes. I think one answer is to teach gender issues in broader history of science classes. A second question is how to get more science students into history of science classes. Gender in science classes draws more science students than general history of science classes.

Sigrid Schmalzer *University of California, San Diego*

Breeding a Modern China: The Making of the Dingxian Pig

“Breeding a Modern China: The Making of the Dingxian Pig, 1929-1937” explores the Mass Education Movement’s efforts to transform pigs and pig breeding in Dingxian, Hebei through the importation of an American breed of pig and its hybridization with local pigs. Led by Yan Yangchu, reformers were conscious that the wholesale importation and implementation of western scientific methods had failed China in the past and would fail again. Their chief concern was that the new pig should raise production levels but still “suit local conditions.” Reformers thus constructed a notion of “local conditions” to which modern science was required to conform. But “conditions” and “methods” do not play equal roles in science, and reformers did not require the “scientific” methods of pig breeding to negotiate with local methods. Despite their attention to local conditions, the reformers thus reinforced the notion that modern, western science was universal in nature, and that it could and should be applied universally, replacing local knowledge and practices. Furthermore, in discussing “local conditions,” reformers found a way of talking about the people of Dingxian that fit their liberal, humanist agenda. This paper examines what kind of society the reformers presented and contrasts it with alternative ways of viewing the same “local conditions.” Finally, the paper explores the relationship between the new methods of pig breeding and the process of state building: the “scientific” methods compelled farmers to participate in state-regulated breeding cooperatives and created a new arena of state control in farmers’ everyday lives.

Rebecca P. Schwartz, *Princeton University*

Writing the Authorized Biography of the Manhattan Project:
Henry DeWolf Smyth and the Smyth Report

The increased authority of physicists as a result of their successful work on the Manhattan Project is a standard theme in the history of American physics. But how did Americans come to know about physicists' work on the atomic bomb, which after all remained entirely classified after World War II, so that the physicists could benefit thereby? An important piece of the answer is the Smyth Report, the official governmental report on the Manhattan Project, which was released days after the atomic bombs were dropped. Coming as it did into a security-imposed vacuum, the Smyth Report served as the sole resource to a nation seeking to learn about this new and fearsome weapon. In this paper, I examine how Henry DeWolf Smyth, a Princeton University physicist, crafted his report to convey to the American people a carefully controlled picture of the Manhattan Project. Using drafts of the report and Smyth's correspondence from the archives of the American Philosophical Society, I show that besides for considerations of national security, Smyth also edited his report to reflect well on the Army and British scientists, to minimize the dangers of radioactive fallout, and, most importantly, to emphasize the roles of physicists on the Manhattan Project while downplaying the vital contributions of chemists and engineers. In doing so, Smyth was guided by his own predispositions as to what constituted interesting science, and what was merely technical problem solving. Although the Smyth Report is not well remembered today, its impact is apparent in the way that so much scholarship about the Manhattan Project continues its emphasis on physicists, implicitly dismissing the others without whom success could not have been realized. This is not necessarily reflective of the reality of the Manhattan Project, but rather of how it was portrayed in this early and important work.

Silvan S. Schweber *Brandeis University*

Interdisciplinarity, Theory, the Computer and the Physical Sciences

Teams of physical scientists—metallurgists, physical chemists, physicists, engineers—had often been organized at the Bell Laboratories and at the General Electric Research Laboratory to solve pressing problems in the development and improvement of particular devices. During World War II research teams in which members of sufficiently different background to cover all aspects of a given situation were assembled to address the problems of designing radar sets, nuclear piles, proximity fuses, atomic bombs, ..., of implementing operational research, and formulating answers to numerous other problems that waging a total war entails. After the war the value of such teams and the contribution of

the specialists on these teams were clearly recognized, but so was the danger of overspecialization in the training of new scientists. Both at Harvard and at Princeton programs were designed to train “scientific generalists” with a command of advanced statistics who would be able to supervise, coordinate and administer such research teams. Statistics would enable the decision problems to be solved when the relevant factors were either not clear cut, or the factors involved too numerous or complex to be analyzed analytically. The computer has replaced this notion of the “scientific generalist”. Over the last two decades scientific computation has reached the point where it is on par with laboratory experiments as a tool for research in physics. The computer is providing a new window through which the natural world is being observed and analyzed in exquisite detail. It has restructured the traditional roles of theorists and experimenters. It also has made for a new notion of interdisciplinarity by building new bridges between disparate subdisciplines, such as cosmology and condensed matter physics, by virtue of common models and simulations. In addition, and just as dramatically, the computer-based Internet has made it possible to communicate easily and reliably huge amounts of information throughout the world. These advances in computing and communication point to a structural transformation of the ways in which understanding is gained in the various subfields of physics. I shall illustrate this with examples from cosmology, condensed matter physics and biophysics.

Marija Sesic *Museum of Science and Technology, Belgrade*

The Electrical Icon: National Appropriations of Nikola Tesla, 1945-1999

The paper discusses the arguments and evidence which the Serbian and Croat politicians, journalists and historians advance to determine the nationality of the electrical innovator Nikola Tesla (1856-1943). Tesla is known as the author of several major patents in the field of alternating electrical current and an advisor in the construction of Niagara power plant. He lived in New York, but his work was closely followed and celebrated in the Yugoslav lands where the issue of his national identity became a matter of considerable controversy, due partly to the fact that Tesla’s family, Serbian in ethnic and religious background, lived inside the borders of the Republic of Croatia (at the time of his birth, Austro-Hungarian Monarchy). In the period from the formation to the end of the ‘original’ Yugoslavia, Tesla’s work was celebrated as intrinsically Yugoslavian. His motto ‘I am proud of my Serbian origins and Croatian homeland’ was often cited in support national toleration, despite the fact that no such claim was ever found in his writings. His portraits appeared on banknotes, in fictional autobiographies, in the names of scientific institutions, and theater performances. This paper will focus on some of the most extraordinary uses of his scientific work and public image and, particularly, on the ways in which his Yugoslavian identity disappeared after the fall of Yugoslavia in 1991.

Jonathan Sheehan *Indiana University*

From Philology to the Fossil:
the Biblical Encyclopedia in Early Modern Europe

What do philology, archaeology, mnemonics, jurisprudence, oratory, optics, rhetoric, grammar, ethics, pneumatics, theology and economics all have in common? All—in the mind of Johann Alsted, a seventeenth-century German polymath—could be comprehended in the vast encyclopedia of the Bible. That the Bible was written word of God is only a partial explanation for Alsted’s position. Unlike previous eras, the seventeenth century gave the motto “there is no book but Sacred Scripture” a literal twist: the Bible enveloped all literature, for Baroque scholars, by virtue of the arrangement and disposition of knowledge inside it. Its pages not only included all the human and natural sciences, but also organized them and gave them recognizable form. Alsted’s dream of an encyclopedic Bible was concretized in various forms over the course of the century, from Samuel Bochart’s *Hierozoicon*, which provided detailed philological and historical investigations of Scriptural animals, to nearly innumerable Scriptural geographies. Read structurally, such works brought an *a priori* (usually Ramist or neo-Ramist) organization to the universe of Biblical knowledge. Only in the early eighteenth century did the Bible itself become an organizational principle, not just for Biblical knowledge but for knowledge in general. Like the alphabet, the Bible was—in such works as the massive Berleburger Bible (1726-1740) and the so-called Copper Bible, the *Physica sacra* of 1731—an arbitrary system for coordinating and encompassing knowledge of both theology as well as human and natural history. If Alsted and other seventeenth-century polymaths placed the Biblical encyclopedia within a deductive and logically systematic structure of human and divine knowledge, by the eighteenth-century, the Bible—its complicated and contradictory histories—itself became the structure. This paper will examine the origins and consequences of this transformation, focusing principally on the *Physica sacra*. This four volume monument—comprising some 800 folio engravings of the natural history of the Bible, paralleled by two translations and extensive scholarly and scientific commentary—shows at its clearest the promise and perils of a Biblical encyclopedia. On the one hand, the *Physica sacra* provided its readers with a compilation and synthesis of a field of knowledge whose perimeters had expanded alarmingly in the last century. Its formal properties in this view gave it a structural and editorial flexibility in the face of unprecedented acceleration of human knowledge. From philology to fossils, the *Physica sacra* promised to cover it all. On the other hand, however, the very form of such a project had profound implications for the status of Bible as the premier text in the Western canon. After all, if the Bible was as arbitrary an organizational principle as the alphabet, how could one say, in good faith, “there is no book but Sacred Scripture”? Although, as I will argue, the Biblical encyclopedia could not survive the paradoxes of its form, the efforts made to produce such texts testify to a profound uncertainty in Early Modern Europe about the horizons of human knowledge, and a profound sense

that such knowledge must—for it truly to remain human knowledge—be contained within human, and humanistic, structures.

Grace Y. Shen *Harvard University*

Mining the Cave:
Global visions and local traditions in the story of Peking Man

This paper will discuss the role of place in mediating the investigation and understanding of the 1926 Peking Man discoveries at Chou-k'ou-tien (Zhoukoudian), China. It is centrally concerned with different aspects of transit between the local and global, particularly how these movements were tethered by both the physical and material circumstances of the cave and the cave's figurative implications. Four conceptions of "place" will be examined to show the suppleness of this concept in action and the versatility of its analytic possibilities. The first example charts the ways in which theoretical concerns, especially the idea of centers of primate dispersal, focused attention on China/Central Asia in the search for early hominids. The second contrasts the "success" of the Peking Man discovery with the "failure" of Eugene Dubois' Java Man find on the basis of consciously developed local institutional structures, such as the Peking Union Medical College Cenozoic Research Laboratory, the Peking University Geology department, and the Geological Survey of China. Third and fourth are two aspects of Chinese national identity which hinged on invocations of place to first embrace the Peking Man find and then to use it as currency in widening international arenas (political and scientific). In one case, Peking Man's habitat is the basis for its enrollment into narratives of Chinese cultural history, and in the other, the possession of the literal remains of Peking Man (actually over 45 specimens) plays into constructions of China as a modern nation-state. Though the meanings of "place," "local," and "global" lay on shifting sand in these varied contexts, the cave functions as a solid space within which interrelations can be negotiated.

Brian C. Shipley *Dalhousie University*

"My fact, therefore, I now consider established beyond controversy":
William E. Logan, the Origin of Coal Debate,
and the Writing of the History of Geology

The question of the origin of coal deposits, contemporary commentators agreed, was one of the most provocative geological issues of the mid-nineteenth century. Although it had already been established that coal was of vegetable rather than mineral derivation, widespread uncertainty persisted as to how this vegetative material had been accumulated into the deposits that eventually became coal.

While it was once generally assumed that massive floods had been responsible for sweeping trees and plants from the land, and depositing this material in lakes and estuaries, new evidence in the 1830s led some observers to argue the alternative, that the plants which became coal had actually grown in the same places where the deposits subsequently formed. Strangely, this debate has not attracted attention from historians commensurate with that which it received from geologists. This is probably partly due to the perception that studies of coal arose primarily from economic rather than scientific motives. However, I aim to show that the development of theories about the origin of coal was intrinsically connected to changes in the understanding of geological processes such as elevation and subsidence, as well as to the new appreciation of the magnitude of geological time. In this paper, I focus on contribution made to the coal debate by William Logan in 1840 (two years before he became the first director of the Geological Survey of Canada). Although his role may have seemed small at the time, he was later to receive most of the credit for establishing the *in situ* theory of coal formation. In addition to reconstructing part of this neglected historical episode, then, I am also concerned to analyze the ways in which Logan and his supporters made use of the recent past to establish their preferred version of events, and their motives for doing so. Their stories, told at the expense of other participants in the debate, have proved to be highly durable, persisting almost unchanged to the present.

Sujit P. Sivasundaram *Christ's College, University of Cambridge*

Objects of this World: Missionaries, Museums and the South Pacific

When the London Missionary Society was formed in 1795, it was decided that the first missionaries should be sent to the South Pacific. These missionaries, and those who followed them, wrote an enormous number of letters and reports, and sent back many 'curious' artefacts. Shells, idols, botanical specimens, spears and Pacific islanders were amongst the trophies sent home. Their supporters and friends returned the compliment by shipping back livestock, steel and printing presses, for example. A missionary museum was set up in London where the relics of 'savagery' could be displayed. Similarly, objects from Britain took pride of place in the houses of certain South Pacific people, who were favoured by the missionaries. This paper will consider the politics of exchange and how integral this was to the representation of a distant place. How did these objects denote that the mission was succeeding? How did mission supporters encourage their agents by sending objects to them? Was there a relationship between the shells and the idols that were sent home or the steel and the livestock that was sent to the South Pacific? Indeed, scientific practices were demonstrated in relation to objects that would not normally be considered under that title. Pacific islanders, who arrived in Britain, for example, were often treated as natural historical specimens. They were on occasion put in cages, portrayed without clothes, and spoken of as wild animals. How did missionaries' museology fit

into their theology? Their emphasis on the objects of this world, would seem surprising given that they were ushering in the world to come.

Charlotte L. Sleight *University of Kent at Canterbury*

Brave New Worlds:
Sociological Explanations of the Ants in the 1920s and '30s

'*Brave New World* presents a ... picture of society, in which the attempt to re-create human beings in the likeness of termites has been pushed almost to the limits of the possible.' Thus Aldous Huxley described his celebrated novel of 1932. The 'picture of society' in question was by no means unique to Huxley his own brother Julian had published a popularizing digest of myrmecological scholarship just two years earlier. The foremost ant scholar at the time of the Huxleys' books was an American, William Morton Wheeler (1865-1937). Wheeler synthesized a top-down model of social explanation—borrowed by the Huxleys—for the behavior of the ant-colony. Investigation reveals that Wheeler worked to create his science within a European tradition of group-based ant/human analogy that may be traced to Espinas and Durkheim from the mid 1920s, Wheeler was specifically inspired by the elitist Italian sociologist Vilfredo Pareto. As a thorough-going sociological approach was introduced into myrmecology, it obscured the significance of the individual ant and, by implication, man. Writers of both entomological and creative literature hastened to exempt themselves from this, their own generalization. In the modernist context, the ant-mass was constructed as the discomfiting mass of civilized society.

Phillip R. Sloan *University of Notre Dame*

German Biology Comes to London:
The Role of the College of Surgeons, 1814-1840

Historians of science have often commented upon the importance of German influences for understanding the early nineteenth century scientific developments in Britain exemplified by Faraday, Whewell, Davy, Lyell, Babbage, Owen, Barry, and even Darwin. However, little detail is available on how German thought was embodied institutionally and concretely transmitted to an Anglophone audience. Although there had been broad contacts in the late eighteenth century, the Napoleonic imposition of the Continental Blockade in 1806 had significantly restricted the interchanges between Continental and British scientists and physicians. This was also represented by a decline in periodical reports on German science. With the end of the Napoleonic wars, a new era of contact was initiated between workers in the Germanies and those in Britain. Travels to the Continent, renewal of study by British students at German universities, and the reciprocal

return of German intellectuals and scientists to the British Isles commenced. One institution, the Royal College of Surgeons of England, home of the great Hunterian anatomical Museum and a prestigious lecture series in Comparative Anatomy, played a central role in the formal transmission of German life science into London in the 1815-1840 period. Its renowned anatomical museum drew a wave of foreign visitors, including leading German scientific figures, to London after the Napoleonic era who made personal contacts with individuals associated with the College. Particularly through the lectures of Coleridge's disciple, Joseph Henry Green, the Hunterian Lecturer in Comparative Anatomy from 1824-29, the College also became a primary vehicle by which the theories and content of German life science and philosophy were transmitted to a London audience. This presentation will focus on two main issues: 1) the renewal of German-English scientific contacts after 1814 2) the role of the College of Surgeons in the dissemination of German philosophy and biology into London in the 1815-40 period.

E. Elena Songster *University of California, San Diego*

Forest Stands for Pandas:
Scientific Forestry and Nature Reserves in Sichuan, China

“Forest Stands for Pandas: Scientific Forestry and Nature Reserves in Sichuan, China” examines the creation of nature reserves in Southwestern province of Sichuan in the People’s Republic of China. Most of Sichuan’s nature reserves constitute (what I call) the “panda belt” of Sichuan. These panda-protecting nature reserves exist in a band of counties that runs through the mountains on the Western rim of the Sichuan basin from the center of the province to its northern edge. Most of the reserves were created following the ideological and political shifts that occurred in Chinese Communist Party as it attempted to better integrate China in the international arena in the aftermath of the Cultural Revolution. For the first time, the 1976 constitution explicitly incorporated environmental protection as a governmental goal and duty. These reserves offered the Chinese government a means of engaging with the international community through the medium of science. In part due to the attention that such unique species as the panda and the golden monkey attracted from both local and international scientific communities, these hinterland areas were transformed into state-protected scientific research reserves. In Sichuan these reserves thus became an important part of the province’s rising image as a modern science center for China. The specialized designation of “nature reserves” attempted to alter the way that the Sichuanese used and perceived the nature and environment of their native province. Government regulation commanded the Sichuanese to become stewards of the disappearing identity through these natural (and now national) treasures that reached back to prehuman existence by employing and supporting cutting-edge scientific advancement. Sichuan’s nature reserves thus created perfect reflections of modern national(istic) space through this obscured sense of time. Through the nature reserves, science

influenced national consciousness, state policy, and drew a link between notions and present and ancient Chinese heritage through the natural geography.

Buhm Soon Park *National Institutes of Health*

More Academic Than a University:

Three Freedoms and the Laboratory of Molecular Biology at NIH, 1961-1981

This essay examines the characteristics of the Laboratory of Molecular Biology as an intramural program of the National Institutes of Health during the first two decades of its operation (1961-1981). My main focus is on the structure and function of this laboratory in the particular institutional setting provided by the federal government, which emerged as a leading patron for biomedical research after World War II. NIH intramural programs in Bethesda had a clearly defined mission—"better health through research"—in common, but a broad interpretation of relevance to categorical diseases allowed various kinds of research activities in many scientific and medical disciplines. In this complex environment of a government agency, researchers inevitably encountered statutory and administrative restraints on the one hand, and pressures for more responsive programs on the other. Yet the disadvantages could be offset by "three freedoms" uniquely available on the NIH campus: freedom to choose research topics without being restricted to the subject of the grant proposal, freedom to devote almost all working hours to research, and freedom from the need to develop "grantsmanship" skills. These freedoms, the essay shows, ensured the autonomy of individual researchers in the Laboratory of Molecular Biology, and fostered a scientific community that encouraged a generous exchange of ideas, a facile initiation of collaboration, and a flexible planning of research. The quality of their research products, in return, helped to convince NIH administrators and outside reviewers of the value of three freedoms in fulfilling the mission.

Richard J. Sorrenson *Indiana University*

From the South Col to South Pole:

Sir Edmund Hillary and the British Commonwealth Expeditions
to Everest and Antarctica in the 1950s

Within less than a decade in the middle of the twentieth century, ambitious nations demonstrated their Cold War vigor by hand picking men to do dangerous things that had not been done before, had no direct economic utility, but were strangely compelling: climbing Mt. Everest, crossing Antarctica, and orbiting the earth. Only the two postwar superpowers (the USSR and the USA) could afford the latter, but Britain, much reduced in influence and wealth after the brutal struggle

of World War Two, set out to demonstrate that it too still had the scientific, technical, and human capacity to be taken seriously on the world stage. To succeed, I shall argue, Britain chose a novel and explicitly post-imperial mode, constructed around the British Commonwealth, to mount complicated, meticulously planned, multinational expeditions to Everest and the Antarctic. In the attempt on Everest, the expedition leader, former army officer John Hunt, considered climbers from Britain, Kenya, Canada, New Zealand, India, and Nepal, while explicitly rejecting those from Europe or the United States. In London, he chose an experienced New Zealand climber, Edmund Hillary, and when in Nepal, he chose the locally eminent Sherpa Tenzing Norgay to join the party. The expedition, after much effort, placed three pairs of men at the South Col of the mountain after the first pair failed in their final assault, Hunt ordered Hillary and Tenzing to try. Upon their successful final ascent, these two members of the British Commonwealth stood at the top of a supply pyramid that had been constructed in London and flung across Asia. Neither Hillary nor Hunt had expected the worldwide adulation that was to follow both constantly emphasized the importance of the entire team. None the less, Hillary used his fame and the geographical proximity of his nation to the South Pole to take a more central role in the trans-Antarctic expedition of 1957 and 1958 which was organized by the British geologist Vivian Fuchs as one of the British Commonwealth's contributions to the International Geophysical Year (IGY). Careful planning, appropriate mechanization, and contributions of funds, personnel, and expertise from Australia, South Africa and New Zealand led to a successful crossing of the continent. Compared to the Soviet or US explorations of space, the Everest and Antarctic expeditions were on a very much smaller scale. Forced by reduced circumstances to operate more modestly, they still managed to complete their missions successfully and to generate worldwide acclaim. Britain, by operating in a new post-imperial mode that relied upon cooperation between like-minded nations, was able to demonstrate that it too had the right stuff in some very cold and hostile places.

Susan B. Spath *Independent Scholar*

A New Cell Theory in 1962: The Procaryote/Eucaryote Distinction

The cell theory introduced in the middle of the 19th century provided a fundamental conceptual lens for perceiving and studying living things. This paper argues that procaryote/eucaryote distinction introduced by microbiologists R. Y. Stanier and C. B. van Niel in 1962 represents a reformation of the cell theory made necessary and possible by and for the new biologies of the post World War II era. Disciplinary politics, new knowledge about the biology of bacteria, and new laboratory practices interacted in encouraging this reformulation. Stanier and van Niel introduced these categories to solve a conceptual problem central to their ambitions to make microbiology into a coherent and rigorous science. From the 1940's on, they

sought to define bacteria as biological entities and to specify their place in the natural order. By 1961, defining bacteria in biological terms had acquired a new urgency. A widening group of researchers were using bacteria to investigate fundamental biological problems, including protein synthesis, the replication of DNA, and the nature of the genetic code. For practitioners interested primarily in molecules, legitimizing bacteria as biological organisms legitimized their tool of investigation. In 1962, Stanier and van Niel proposed the terms procaryote and eucaryote to refer to two fundamentally distinct cell types, based on the details of their plan of organization. Conceiving of bacteria as procaryotes gave these once marginalized organisms a clear and important position in the order of nature. The procaryote/eucaryote distinction ended the conventional belief that plants and animals represented the fundamental bifurcation among living things. The new term also signified the dual nature of the bacterium as organism and as technology. From the 1960's through the 1980's, the procaryote/eucaryote distinction served as the generally accepted version of the cell theory.

Matthew Stanley *Harvard University*

Science and the Spiritual Quest:
Religion, Epistemology, and Eddington's Stellar Models

Arthur Eddington, the British astronomer best known for his stellar models and the 1919 eclipse expedition to confirm general relativity, developed a philosophy of science closely related to his Quaker faith. This faith stressed the rejection of a need for dogmatic certainty in favor of a spirit of continual seeking for spiritual truth. His religious beliefs provided conceptual resources for constructing a view of science as an open-ended enterprise in which theories were not valued for their certainty or finality, but rather by their ability to allow further scientific investigation. This paper argues that this philosophy was fundamental for the creation and use of Eddington's models of stellar structure.

John Stenhouse *University of Otago*

Protestant Missionaries and Modern Western Science 1790-1930

Historians of science have only recently begun investigating the relationship between the modern Protestant missionary movement and modern Western science. This paper argues that missionaries played a modest role in the production of modern Western scientific knowledge, particularly in natural history, ethnography, and the biomedical sciences, and a more significant one in helping disseminate Western science to the world, particularly during the heyday of missionary science between about 1870 and 1930. Complexity and

ambivalence characterized each aspect of the triangular relationship between Protestant missionaries, Western science, and their host cultures. The missionary movement, while containing those eager to cultivate sciences such as geography and medicine to facilitate evangelism, also contained pietists who warned more scientifically-oriented colleagues against anything except direct evangelism. Missionary suspicion of ‘godless’ Western science burgeoned in the post-Darwinian era, as apostles of T.H. Huxley spread the gospel of scientific naturalism. Ambivalence also characterized host cultures’ reception of missionary science. Many simply ignored or rejected the missionaries and all their works. Yet even in the toughest mission fields such as China and India, modernizing élites intent on strengthening their nation embraced missionary science, and plenty of ordinary people found healing in missionary medicine. Despite the ambivalence they encountered from missionary colleagues and many of their hosts, Protestant missionaries played a significant role in the globalization of Western science.

James E. Strick *Arizona State University*

Cell Symbiosis Theory from Mereschkovsky to Exobiology

The concept of endosymbiosis as the origin of eukaryotic cells and/or their organelles began around 1905 with theories of the Russian biologist Mereschkovsky. As Sapp, Khakhina and others have shown, numerous additional contributors, e.g. Paul Portier and Ivan Wallin, added observations to support this theory throughout the twentieth century. The concept ill fit existing cell theory, however, until the establishment of the prokaryote/ eukaryote distinction in the 1960s and the work of Lynn Margulis beginning in 1967. This paper will bring up to date the status of endosymbiosis theory since Sapp’s 1994 account, focusing on the claims that are still not widely accepted such as the spirochete origin of eukaryotic “flagella” (“undulipodia” of the Margulis school), origin of centrioles and mitotic spindle apparatus, and origin of the eukaryotic nucleus from fusion of multiple eubacterial and archaeal DNA units. More importantly, I will show how integral endosymbiosis theory has become to the entire new discipline of exobiology and how cell theory has changed in fundamental ways since the 1960s, under the influence of exobiology generally and cell symbiosis theory in particular.

Alice Stroup *Bard College*

Duclos on Boyle:

A French Academician Criticizes ‘Certain Physiological Essays’

The two principal scientific societies of the late 17th century counted alchemists

among their number. With historians now acknowledging Robert Boyle's marriage of corpuscularian and alchemical traditions, it is important to examine the vitalist corpuscularianism of Samuel Cottureau Duclos (d. 1685), the alchemist of the *AcadÉmie royale des sciences*. Although in 1668 Duclos analyzed Boyle's *Certain Physiological Essays* for his Paris colleagues, his remarks (surviving in three manuscripts in Paris) remain neglected by historians, who have mistakenly assumed that they concern Boyle's *Sceptical Chymist*. Yet Duclos's remarks are crucial to understanding the theoretical contexts within which savants, individually and collectively, carried out their researches. Hence the Academy's cryptic verdict, published in its earliest histories, that Boyle was more the philosophical, Duclos the more chemical, savant. Duclos's critique clarifies the polemical usage of "alchimie," "alchimiste," "hermÉtique," "platonisme," and "chimie" during a period when the fledgling *AcadÉmie* was protecting what we might label "scientific Gallicanism," that is, the right of savants in France to inquire freely into natural philosophy. Moreover, by criticizing the metaphysical engine driving Boyle's interpretations of experimental data, Duclos distinguishes his own corpuscularianism from that of Boyle. As a hitherto unknown link between the London and Paris scientific societies, Duclos's critique of Boyle helps us set the record straight by comparing these two (al)chemists, and (in the process) reconsidering English and French science in the 1660s.

Abha Sur *Massachusetts Institute of Technology*

Identity and Ideology in Meghnad Saha's Physics

Meghnad Saha (1893-1957) was one of India's foremost physicists. Saha's ionization theory of gases had a profound impact on astrophysics as it changed astronomical spectroscopy from a qualitative tool for classification of stars to a precise technique of quantitative measurements. Its simple integration of atomic physics with thermodynamics established the fundamental link between microscopic and macroscopic phenomena. Stewart A. Mitchell credited the ionization theory for illustrating the essential unity of astronomy where spectra of gigantic stars could provide information about the size of a tiny atom and where a deeper understanding of the physics of the evolution of stars or the structure of the universe necessarily involved "an intimate study of the ultimate constitution of matter." In this paper I juxtapose Saha's scientific writings with his commentaries on civic society to draw out the philosophical essence of his science. I suggest that while hierarchical caste distinctions of the Indian society as well as pervasive "orientalism" of the West mediated Saha's social interactions with other scientists, his opposition to caste ideologies and his egalitarianism found a strong expression in his science.

John P. Swann *U. S. Food and Drug Administration*

Institutionalizing Regulatory Science and Research in the FDA

The pursuit of science and research at FDA developed as a function of the agency's core mission to protect consumer health, an endeavor certainly shaped by many developments beyond the agency's direct control. Thus, among the factors that have influenced the development of science in the FDA in the past one hundred years are legal mandates, requirements of public health disasters, changing philosophies of regulation in the executive branch, the demands of a beguiling and sophisticated marketplace, and the unique interests of regulated entities. The assorted internal reorganizations wrought by these external stimuli have in turn had an impact on the practice of science. The scientific requirements of the agency's mission also necessitated collaborative work with outside individuals and institutions, such as the development of methods of analysis under the auspices of the Association of Official Analytical Chemists. Taking into account some of these influences, this paper will discuss the development of science and research as a recognized function of the FDA's field offices and headquarters, where different regulatory responsibilities affected the way science and research evolved. Case studies that focus on specific laboratories, offices, and regulatory events from different eras will be used to illustrate the process and extent to which science became institutionalized in FDA.

Scott D. Tanona *Indiana University*

Bohr's Correspondence Principle: Deducing Atomic Structure from Spectral Phenomena

Niels Bohr's correspondence principle played an important role in the development of the quantum theory and was of utmost importance to Bohr's early thought. Although others working on the quantum theory questioned the status and role of the correspondence principle, Bohr insisted that it was actually a principle of the quantum theory and not just a heuristic device. In this talk, I will argue that Bohr elevated correspondence to a principle of the quantum theory because of its importance in the general methodology he was using. Partly in response to public and private criticism of the principle by others, especially Sommerfeld, Bohr strengthened his position on its status, declaring it to be part of an overall method and claiming its superiority over other methods available. Bohr's early justification for the correspondence principle had been that it was 'suggested' by certain similarities between the predictions of atomic spectra made by classical physics and the new quantum theory. But the principle went beyond these asymptotic similarities. Rather, Bohr eventually made clear, it declared a direct connection between the frequencies of light in an atomic spectrum and certain classical motions in the atom. This connection justified

a direct inference to what otherwise were unwarranted assumptions about the atom. I will argue that taking seriously Bohr's comments on method allows us to make sense of his otherwise mysterious insistence that correspondence had to be a principle of the quantum theory. I will also suggest an alternative way to understand his insistence on the necessity of classical language.

Philip M. Teigen *National Library of Medicine*

Science, Society, and Culture in the Establishment
of the Harvard School of Veterinary Medicine

During the presidency of Charles W. Eliot (1869-1909), the teaching of science at Harvard University was transformed. New sciences were added to the curriculum and old ones revived and reformed. Uneasy at first with the production of scientific knowledge for its own sake, with its emphasis on explanation, abstraction, and universality (*techne/episteme*), Eliot focussed his early reform efforts on educating practitioners whose knowledge and action could improve Massachusetts' society, economy, and culture (*phronesis*). Chief among them were lawyers, physicians, agriculturalists, and veterinarians. His establishment in 1882 of a landmark school for veterinary surgeons provides a case study of how Harvard's most famous president saw science serving the needs of post-Civil War Massachusetts. Eliot established the University's veterinary school in order to graduate a few qualified practitioners. He felt they could improve the public health, then afflicted by slaughterhouse offal in its water supply, diseased meat on its tables, and animal-borne diseases around every corner reduce economic losses to the meat industry, transportation system, and farmers threatened by epizootic diseases of cattle, horses, and swine and contribute to moral reform by collaborating with the Commonwealth's vibrant anti-cruelty movement. This paper reconstructs the circumstances of post-Civil War Massachusetts which led Eliot to introduce veterinary education into the American university.

Mary Terrall *University of California, Los Angeles*

Vis Viva Revisited

The *vis viva* controversy is a canonical site for analysis of irreconcilable philosophical positions in early-modern physics. Viewed retrospectively, in light of subsequent formulations of the concepts of energy and momentum, the endless wrangling of the participants reduces to confusion, and not much else. What more can be said about this controversy, disdainfully characterized in 1743 by d'Alembert (among others) as "a dispute of words too undignified to occupy philosophers any longer"? This paper looks at the trajectory of the dispute from the point of view of the alliances and antipathies connecting and

dividing the antagonists. These relations were governed in part by philosophical commitments, but also by institutional and personal allegiances that were played out in academic prize essays, in the periodical press and in books. The controversy simmered for many years within the small international community of mathematicians, flaring up occasionally into more or less vitriolic arguments that were never resolved. It bubbled over into greater public visibility when Emilie Du Châtelet and Voltaire entered the fray in the 1740s. By this time, the arcana of 17th-century dynamics had become the stuff of Enlightenment posturing. Why did Voltaire care about this question? Why did he think his public would care? And why were others, arguably more mathematically astute, focusing on other physical laws and concepts altogether? Inspired by these questions, the paper investigates the interests and motivations at play at several key moments in the complex history of this dispute.

Hereward Edmund Tilton *University of Queensland, Brisbane, Australia*

Count Michael Maier and the ‘Imposture’ of Rosicrucianism:
Defending Alchemy in a Virtual Arena

The anonymous Rosicrucian manifestos that appeared in the midst of Counter-Reformation Germany gave expression to a Paracelsian-inspired Hermeticism and a heterodox Lutheranism with strong millennialist overtones; they purported to stem from an order of pious scientist-monks, the ‘Brethren of the Rosy Cross,’ who were acting as the harbinger of an age in which the *prisca sapientia* would be restored. On account of his leading role as apologist for this ‘Fraternity’, Count Michael Maier came to be known as a man who not only squandered his talents on the impossible claims of alchemy, but who was also duped by the Rosicrucian ‘imposture,’ as Newton would put it when reviewing Maier’s Rosicrucian writings. Over the centuries, a plethora of traditions have grown up amongst those who have devoted their time to uncovering a true secret society lying behind the manifestos. As I shall demonstrate in the course of the proposed paper, the ‘Rosicrucian fraternity’ existed in a very real and important sense, albeit a virtual one. For the manifestos gave rise to a flood of publications that constituted, in effect, a virtual arena for the definition and defence of Protestant Hermeticism in the years preceding the Thirty Years War—an arena which Maier utilised to justify his own non-Paracelsian brand of alchemy. Such was Maier’s success in exploiting the Rosicrucian phenomenon as a vehicle for his own ideas that he came to be known by the Jesuit detractors of Rosicrucianism as the ‘secretary’ of the ‘Fraternity.’ Whilst discussing the nature of the alchemy Maier promoted in this fashion, it will be seen that the relation of his ideology to his laboratory practice—no less than his role in the history of Western esotericism—presents difficulties for the historiography and nomenclature recently proposed by Principe and Newman.

Elizabeth A. Toon *Cornell University*

Measuring Up:
Educators, Schoolchildren, and Representations of Physical Growth
in the Interwar U.S.

In the 1920s and 1930s, leading educators set out to revolutionize the ways in which American schoolchildren learned about their health. Energized by new biomedical knowledge and new philosophies of education, these experts stressed the acquisition and practice of health habits and “learning-by-doing” classroom activities intended to demonstrate the relevance of biomedical science to everyday life. The ultimate expression of this new approach to health education, this paper explains, was its emphasis on measuring and representing children’s physical growth. Model curricula and educators, handbooks prodded teachers to devise activities requiring children to chart their own growth and that of other organisms, while textbooks narrated the progress of fictional classrooms where students meticulously tracked physical growth and its relationship to health habits. By the end of the 1930s, two strategies for representing health scientifically came to dominate school health education. The first was the growth curve, where progress was typically represented by children climbing and planting a flag atop the “Hill of Health.” The second was the tale of the two rats, which juxtaposed pictures of a healthy rat and his withered, scrawny, or bow-legged twin and drew a scientific moral about children’s health habits from the differences in the rats, fates. As an instructional focus, these representations of growth seemed especially versatile and meaningful. Growth was an exciting personal event for children, and thus considered likely to spur their interest in a previously dull subject. Moreover, educators argued, teaching children to chart their height and weight progress or the relative growth of organisms introduced them to scientific method—observation, measurement, and quantification. This precision was especially attractive to educators who were expected to convey a broader, positive definition of health—“Health is what Nature gives you plus what you give yourself,” for instance, to their young charges. Finally, growth was an event which adults hoped to monitor and control. In some school systems and often at the behest of foundation and government sponsors of school health programs, educators and health workers used aggregate progress in height and weight as one measure of the efficacy of health education. In this context, I argue, the upward march of children’s growth curves signaled to observers not only that children had learned to understand their physical selves in scientific terms but that school health advocates had tangible evidence that their interventions had been worthwhile. In everyday practice, educators found that their own progress towards this new, more self-consciously “scientific” health education was more difficult than anticipated. Several prominent child health experts argued that the relationship between gains in weight and gains in health was far more ambiguous than assumed. Furthermore, skeptical educators suggested that

classroom activities based these representations of health could be successful only in the hands of the finest and luckiest teachers. Even if the instructor managed to avoid the “false analogies” that had pervaded earlier nature-study approaches to science teaching, the natural world was far too uncertain to ensure a consistent lesson, even in a controlled classroom experiment as one educator explained, rats and rabbits, “like children, show disturbing discrepancies between behavior and its apparent results.... The wrong one is too apt to gain, or the right one to cap the climax all too effectively by dying.” Nevertheless, the history of these strategies for representing health is important, I conclude, for it helps reveal how twentieth-century Americans acquired a new language—one with a scientific inflection—for thinking about their bodies and their world.

Alain Touwaide *Independent Scholar*

Arabic Science in Byzantium: The Case of Botany

Byzantine manuscripts contain, from the 13th c. A.D. onwards, a kind of text without precedent: multilingual lexica of plant names, in fact of plants used in therapeutic as *materia medica*. Even though some among them were previously noticed, these lexica have not been explored. On the contrary, they were neglected as they were considered a minor genre, the sign of a degradation of the ancient tradition or an incomprehensible kind of works. From a systematic inventory and an historical study of these lexica, it appears that they aimed to allow Arabic speaking physicians to read Greek treatises, and conversely, and that they result from a massive income of Arabic medicine to Byzantium from the 2nd half of the 13th c. A.D. onwards. Now, Baghdad was taken in 1258 by the Mongols and, in 1261, Constantinople, previously occupied by the Western Crusaders, was recuperated by the Byzantines. It seems, thus, that, due deep militaro-political changes, the geography of science was transformed. In the specific case of Botany, not only plant names, but also new species were imported in Byzantium from Baghdad.

Ljubinka Trgovcevic *Historical Institute, Belgrade*

Science of Borders:

The Uses of Jovan Cvijic’s Geography at the Paris Peace Conference, 1919-20

The paper discusses the interaction of Yugoslavian scientists and state politicians during the First World War, when geographical, ethnological, and geological researches provided justification for the military actions and the negotiations on the shape and extents of national borders. In 1919-20, the prominent Serbian geographer Jovan Cvijic, author of the influential *La*

peninsule balkanique (Paris, 1918), appeared as a scientific adviser for the Yugoslavian committee on national borders and territorial issues, which participated at the Paris Peace Conference. Cvijic recommended that the negotiations on the issue of post-war national borders ought to embody the natural and social factors developed in his scientific work and asked for a thorough understanding of topographic, ethnic, economic, and strategic aspects of the Balkan lands. Inevitably, however, diplomatic priorities began to color some elements of Cvijic's proposal: for instance, the Committee failed to give a good explanation for the territorial demands with regard to Bulgaria and Hungary, in which cases economy and politics overpowered Cvijic's holistic approach. The paper will focus on the role of science in the peace process and the "expert construction" of early Yugoslavia.

Karin Tybjerg *Department of History of Philosophy of Science, University of Cambridge, UK*

Wonder Making and the Rhetoric of Wonder in Hero of Alexandria

In this paper, I examine the rhetoric of wonder in the work of Hero of Alexandria (1st century AD). Hero wrote on a broad range of topics including the construction of catapults, automatic theatres and magic mirrors, and many of the devices he describes are designed to produce spectacular effects. I shall demonstrate how Hero employs a rhetoric of wonder, which combines the status of philosophy with the power of public spectacles. In his *Metaphysics*, Aristotle tells us that contrary to the arts, which were often motivated by lowly practical utility, philosophy originates in wonder, and the findings of philosophical inquiry cause wonder because of the surprising insights such inquiry yields. Hero employs a similar rhetoric to invest his theories with the power of penetrating behind what meets the eyes: 'We will wonder at things which, when we have proved them, are contrary to what is manifest to us'. At the same time, however, he challenges Aristotle's separation of wonder and utility. Hero emphasizes that subjects such as pneumatics and catoptrics provide for utility as well as for wonder and he attempts to blur the distinction between them. Furthermore, the machines described by Hero show that mechanics not only explains phenomena that cause wonder, but also controls wondrous mechanical spectacles. Lastly, Hero's production of spectacles gains an extra dimension because they resemble the kind of automata and devices that were employed at banquets, processions and festivals to demonstrate political and social power. I argue that, with his rhetoric of wonder, Hero attempts to escape the banal image of machine-making by providing philosophical insight, while maintaining the power associated with the control over useful and spectacular devices.

Conevery Bolton Valencius *Washington University*

Inside, Outside, Valley, Field:
Miasmas and Healthy Places in the Antebellum U.S.

Newcomers to the pre-Civil War Mississippi Valley experienced a range of places as 'healthy' or 'unhealthy,' 'sickly' or 'salubrious.' This paper explores the variety of sites that antebellum Americans (and new immigrants) experienced as possessing 'health.' Miasmas, I will argue, implicated indoor spaces as well as external environments in the healthfulness of a place: the boundary between 'wild' and natural environments and bounded, domestic ones was porous and often permeated. Many different ranges of space, moreover, could possess 'health': both 'the Mississippi valley' and a nearby riverbottom could be meaningfully spoken of as being 'healthy' or 'miasmatic.' 'Health' was thus a concept that carried both great specificity and great range: every environment, in the logic of the early and middle nineteenth century, possessed influences that wrote themselves into and onto the human form. No place through which human beings moved was neutral territory.

Ellen J. Valle *University of Turku, Finland*

From Sloane to Owen:
Epistolary Episodes in the Construction of Natural History

The epistolary genre was central to the working of the scientific discourse community and the development of scientific discourse throughout the 17th and 18th century. New information and ideas often circulated within groups linked together by correspondence these groups varied considerably in size and in their degree of compactness vs. diffuseness. The face-to-face discourse of the Royal Society at the weekly meetings was often based on letters received or written. Ultimately, these letters might end up published, in the *Philosophical Transactions* or elsewhere. Letters were particularly important in natural history, since this field of study encompassed areas geographically remote from the center. Letters from the periphery to the center might be used to convey information about new observations and requests for books and supplies to accompany a specimen being sent to London or to submit an official report to the authorities (the Admiralty, for instance). Traveling in the opposite direction, letters could send directions for exploration or request particular specimens (a plant for a patron's garden or a particular fossil bone). In the 19th century, the epistolary genre is usually considered to be less important. In natural history and the life sciences more generally, however, it continued to play a role Darwin's use of letters, to elicit information about variation both from professional biologists and from amateurs and 'fanciers', is well known. Likewise Richard Owen embeds letters in his published work

to convey information obtained from colonial (usually Australian) observers, and to transform these observations at the periphery into scientific knowledge. In my paper, I analyze the use of letters in the domain of natural history in and around the Royal Society, from Sloane at the beginning of the 18th century to Owen at the end of the 19th. The perspective and methodology applied are those of linguistic and rhetorical discourse analysis, focusing on the ways in which the letters construct a center and a periphery in the natural history of their time.

Frans H. van Lunteren *Institute for History and Foundations of Science,
Utrecht University*

Paul Ehrenfest and Dutch Physics in the Interbellum Period

Following his call to Leiden as Lorentz' successor, Ehrenfest radically transformed the local culture of physics and especially theoretical physics. His educational reforms payed of handsomely as evidenced by the remarkable careers of his students. Apart from his success as a teacher I will evaluate the rationale and the effects of three main concerns of Ehrenfest: the reorientation of Dutch research towards the new physics (relativity and above all quantum physics), the promotion of contacts between young Dutch physicists and their foreign peers (especially those from Russia and the United States), and the establishment of stronger ties between Dutch academic and industrial science (focussing on the Philips physical laboratory).

Lea Velho *State University of Campinas*

The Role of External Funding in Social Sciences Research in Uruguay during the Military Regime (1973-1985)

The 1973 break with democracy and the 1974 intervention of Uruguay's only university, led to the restructuring of Uruguayan scientific practice. Concerning the social sciences, certain private research centers arose partly thanks to the financial assistance that they received from various international and philanthropic foundations. These private centers continued with investigative work and the formation of human resources during the military dictatorship (1973-1985). Our study draws from interviews with key informants and from primary documents found in the archives of the Uruguayan state (CIEDUR, CIESU, CINVE y CLAEH) and foundation repositories (the Ford Foundation International Development Research Centre, IDRC, Canada and the Swedish Agency for Research Co-operation with Developing Countries, SARECO). We propose to analyze the role of external financing on the establishment of research plans and in the selection of subjects in Uruguayan Economy and Sociology.

Hebe Vessuri *Venezuelan Institute of Scientific Research (IVIC)*

Venezuelan Oil and the Building Up of National Science & Technology
in the Cold War

The Cold War has been thought as a continuation of the second world war years. Although the process was first and foremost American, British and Soviet since these countries immediately fought the cold war, it did not leave other nations untouched. The second world war marked an important watershed in many fields of science, not entirely due to federal and military sponsorship, but when science became increasingly integrated into its economic and political environment. The war led to profound transformations in what it meant to be a scientist, as became increasingly clear in the following decades. Trying to add facets to the understanding of the nature of international science in that period, I propose to analyse the interactions, constraints and opportunities that opened up to scientific practice in the national context of a developing country which, by reason of its strategic natural endowment, acquired some diplomatic significance for the Western powers: oil-producing Venezuela. I will consider the discontinuities within the process of emergence of a scientific community, putting the lens upon the novelties brought about by the new international post-war scenario. Among the questions I will tackle are: What was the new role of the military in Venezuela since 1948 and the fractures among the intellectual, business and industrial elites that emerged during the 1950s? In what ways was international science perceived by Venezuelan scientists as a tool in promoting modernization? To what extent and in what manner foreign diplomacy influenced the direction of the main research and training programs in the country, in conditions in which Venezuela had the ability to self-finance them from its oil wealth? What Venezuelan groups of scientists were more internationally inclined or became involved in activities of international science? What factors stimulated them to involve themselves in those activities? Were there some disciplines more actively engaged than others in internationalization? Which ones? Were there sociocultural or socioeconomic features allowing to differentiate the participants in these research activities or in the promotion of international science? What was the relationship between public science, private technology and economic and political power as far as petroleum was concerned?

Anne C. Vila *University of Wisconsin, Madison*

Sex, Procreation, and the Scholarly Life from Tissot to Balzac

Although 18th-century France is generally considered a golden age for the intelligentsia, it was also a time when scholars were frequently depicted as freaks of nature, social misfits, and/or hypochondriacal invalids. The perceived conflict between thinking and the body often focused on women scholars, particularly after physicians like P. Roussel began to insist in the 1770s that the female

constitution was altogether unsuited for intense study. However, the monstrosity ascribed to female intellectuals stemmed not just from misogyny, but also from an alarmist conception of the physiology of thinking itself. The Swiss physician S. A. Tissot's treatise *De la santÉ des gens de lettres* (1766) popularized the notion that sustained mental activity could have grave bodily effects, including that of drawing too much energy away from the reproductive organs. Tissot's portrait of great thinkers as unfit for procreation struck a resounding chord in French culture: it contributed to the populationist fever of the day, spawned a sub-genre of hygienic manuals for scholars, and confirmed the already widespread sense that philosophes were poor spouses and parents. The ambiguities surrounding scholars intensified in the 19th century, as the perceived relationship between intellectual creativity and fecundity grew even more complicated. Drawing on physiologist X. Bichat's theory of limited vital energy, medical writers like J. J. Virey contended that the body's "cerebral" versus "genital" poles were so antagonistic that true scholars should abstain from sex altogether. Nor did thinkers fare much better in the period's imaginative literature: Honoré de Balzac, for example, borrowed from contemporary medical constructs to dramatize the idea that genius imposed severe, sometimes fatal strains on both the body and social existence. In novels like *Louis Lambert* (1832) and *Béatrix* (1845), Balzac presented protagonists so torn between their brilliance and desire for conjugal pleasure that they ended up mad, dead, or monastic.

James R. Voelkel *Johns Hopkins University* and
Owen Gingerich *Harvard University*

Giovanni Antonio Magini's 'Keplerian' Tables of 1614 and their Implications for the Early Reception of Keplerian Astronomy

In 1614, just five years after Kepler published his strange and challenging *Astronomia nova*, Giovanni Antonio Magini (1555-1617), professor of astronomy at the University of Bologna and one of Europe's foremost astronomers, published 'Keplerian' tables in his *Supplementum Ephemeridum*. At first blush, it would seem that Kepler's book had had immediate influence. An analysis of Magini's hitherto unexamined tables, however, reveals that Magini had read Kepler quite closely but extracted findings from the *Astronomia nova* equally selectively. By doing so, he was able to reduce the error of predicted locations of Mars by several degrees over Ptolemy and Copernicus, but without accepting Kepler's area law, thereby avoiding the unsatisfying and time-consuming iterative calculations it required. Magini's tables would have been more streamlined and intelligible to contemporary users while equaling Kepler's accuracy in principle. Understanding Magini's instrumentalist adaptation of Kepler's findings gives us a new perspective for studying the influence of Keplerian astronomy in the period before Newton. Kepler's influence should be sought not in the adoption of his "laws" (so-

called because of their Newtonian importance) but in more significant, though lesser known, innovations in his treatment of the earth's orbit.

Ulf von Rauchhaupt *Max Planck Institute for the History of Science*

Colorful Clouds:

West Germany's First Steps into Experimental Space Science in the Early
1960s

In late 1959, the West German federal government and German Scientists started to think about how to enter the space age. These plans were triggered by American offers to fly German instruments on US rockets and satellites. After the foundation of NASA in 1958, such offers had been advertised also to other western nations. But unlike other nations, West Germany had long stayed away from everything related to rockets because of the Peenemuende legacy—and consequently from building rocket-borne hardware. Now West German Politicians and Scientists quickly agreed to set up an experimental group affiliated with Werner Heisenberg's Max Planck Institute, where Ludwig Biermann had been doing theoretical space plasma research since the early 1950s. Top of the list of intended research topics for the new group championed by Heisenberg and Biermann were the "hot" topics of the time: cosmic ray research and the newly discovered radiation belts. However, when the group eventually took up work in late 1961, their first—and for some years only one—project was something rather different and novel: ionospheric and magnetospheric research by means of ion-clouds released from sounding rockets in high altitudes. These ion-cloud experiments grew out of an idea by Biermann to probe the solar wind with "artificial comets" made of metal vapor, photoionized and excited by sunlight. This change of program not only reflects the different contexts of the plan and its realization but also the changes of those contexts themselves. The most notable of these changes was driven by the efforts towards a European Space Research Organization (ESRO) for which first ideas surfaced in early 1960. However, both the difficulties with starting experimental research from scratch and doing it in an dynamic international environment were dealt with in an institutional tradition which favored personality over structure.

Andre Wakefield *Dibner Institute for the History of Science and
Technology*

Science and Silver in the Mines of Central Europe, 1650-1850

My paper explores the place of the mining sciences (e.g., metallurgical chemistry, geognosy, mineralogy, geology) between the 17th and 19th centuries. In order to comprehend the perceived purpose of these sciences for contemporaries, we need first to understand the larger "economy of the mines,"

i.e., the system of administrative, fiscal, material, and technological demands that defined them. By sketching the economy of the silver mines, I intend to offer a fresh context for a wide range of literary and scientific production. My paper draws mainly on unpublished archival records from the fiscal and mining bureaus of Saxony, Hanover, and Prussia.

Olivia Walling *University of Minnesota*

The Intellectual and Social Life of Nineteenth Century Laboratory Methods,
A Longhorn View

With the expansion of the cattle industry after the Civil War, the disease “Texas cattle fever” began appearing in epidemic proportions among cattle native to the northern United States. In 1866, the New York Metropolitan State Board of Health began to investigate Texas fever. By the time that the federal government tackled the problem in the 1880s, agricultural experiment stations in four states were already researching the disease. All of the investigators involved in this research adhered to the methodologies associated with the introduction of laboratories that marks a well-known watershed in the history of science and medicine. The study of Texas fever during this time period, however, shows that our assumptions about this “laboratory revolution” need revision. My paper will use Texas cattle fever as a case study to explore the introduction of laboratory techniques and tools in the late nineteenth century. In attempting to isolate the cause of the disease, researchers at the Bureau of Animal Industry and elsewhere hybridized laboratory techniques with existing natural history and clinical techniques and, in so doing, they transformed the laboratory into a productive research tool. In short, the new epistemology was insufficient to produce a revolution in medicine. Instead, laboratory science emerged triumphant because it was shaped in the crucible of the social, economic, and political milieu that placed new demands on scientific research.

Lisa H. Weasel *Portland State University*

Race and Gender through the Microscope:
A Feminist Perspective on Henrietta Lacks and the HeLa cell line

The relationship between race, gender and the history of science must be understood as a complex intersection between the social context of science and its historical practice, as well as the subject matter itself. The case of the HeLa cell line, the first *in vitro* human epithelial cancer cell line to be established in the laboratory, provides an opportunity to examine the ways in which race and gender have intersected with the history of science at all of these levels. The cells that make up the HeLa cell line were initially taken from a cervical biopsy performed in 1951 on an African-American female patient by the name of

Henrietta Lacks, at the Johns Hopkins University Hospital. Although Lacks died just 8 months following the biopsy, her cervical cells lived on, and since that time have been used by scientists the world over in a multitude of experiments ranging from testing the Salk polio vaccine to basic cancer research. While the HeLa cell line ostensibly lost its connection to race and gender once in the petri dish, the context of these cells and the way that they have been and continue to be represented in the popular and scientific literature retain vestiges of the socially-derived connection between science and race, class and gender stereotypes. Furthermore, current scientific debate regarding the naming of this cell line and its potential classification as a new, non-human species requires that the historical context of race and gender in this scientific story be acknowledged and attended to. This paper will present a feminist perspective on the case of Henrietta Lacks and the HeLa cell line, showing how race, gender and science intersect in both the practice and the subject matter of science.

Kathleen A. Wellman *Southern Methodist University*

Physicians and Philosophes:
Biology and Sexual Morality in the French Enlightenment

The eighteenth-century saw a great revival of interest in medicine and physiology, areas which would eventually take shape as the biological sciences in the nineteenth century and which led to much investigation and speculation about living creatures. The emphasis on the biological served many functions in the texts of the period—it caused a redirection of scientific interest away from the mechanical and the mathematical and towards the natural sciences in general and functions of living creatures in particular. The emphasis on the biological was particularly influential in altering the understanding of human beings. They were much more clearly integrated into an understanding of natural processes, much less likely to be separated by a distinctly human soul, directly compared to animals in their abilities, etc. Biological interest led to much speculation about sexual mores and morality. This paper will compare and contrast the treatment of sex by enlightenment physicians and philosophes. It will focus in particular on the works of Nicholas Le Cat, Antoine Le Camus, Jean Astruc, and Pierre Chirac. There are many points of similarity between physicians and philosophes. Because physicians sought relief from pain for their patients, many of them were inclined to advocate tolerance, a perspective they shared with their philosophical counterparts. Both groups explored connections between sex and disease (obviously venereal diseases but also mental illnesses) and highlighted the role of sex in human nature. But physicians were inclined to take a more therapeutic approach, narrowing both the extent of the problem and the scope of its treatment. They also used the biology of sex to enhance their professional authority. The philosophes, in particular La Mettrie, Diderot, Holbach (even more moderate thinkers like Voltaire) were willing to advance a much more radical biological agenda through unfettered speculation.

Petra Werner *Berlin-Brandenburgische Akademie der Wissenschaften*

Composing the Picture of Nature,
or Alexander von Humboldt's English Correspondents

In this presentation, I will describe the extent to which Alexander von Humboldt's English correspondents helped him construct the picture of nature found in his book "Cosmos, a Sketch of a Physical Description of the World." I will base my evaluation on the correspondence he carried on with English naturalists. (Many of these letters remain unpublished.) Humboldt himself depended on these letters from English colleagues, citing them often, for the composition of that five-volume work of his later years. He carried on a correspondence with a total of 109 English scientists and writers (a list will be presented), of which some 38 are mentioned in "Cosmos"—along with citations of their work and letters. The extent of the correspondence with a given individual does not always indicate its significance for either of the writers: a rather detailed correspondence exists with Herschel, but only a few letters passed between Humboldt and Darwin. Yet Darwin was an important correspondent for Humboldt. The contact made with most of Humboldt's English colleagues had not only a scientific component, but a social one as well—indeed, both aspects of the relationship overlapped. This relationship became particularly important for Humboldt when he was attacked in some reviews by prominent English writers—he expected support from his friends.

Simon R. E. Werrett *Max Planck Institute for the History of Science*

An Odd Sort of Exhibition:
Spectacles of Science and the Russian State in the Eighteenth Century

In 1675 a young Gottfried Wilhelm Leibniz wrote a memorandum describing "An Odd Thought concerning a New Sort of Exhibition." One of Leibniz's first designs for an Academy of Sciences, the "Exhibition" he described was a distinctly dramaturgical, spectacular form of operation, hybridizing Francis Bacon's Solomon's House with the theatricals of German carnival. This paper follows the Leibnizian exhibition into reality as it traces the role of spectacle in the formation of the St. Petersburg Academy of Sciences in early eighteenth-century Russia. The place of spectacle in the history of the sciences in Russia has been neglected in the past, but for the first fifty years of its existence, academicians produced spectacular theatricals such as allegorical fireworks displays and museological shows which served to bind the Academy to the Russian court and government. I explore how these spectacles promoted academic and courtly concerns by focusing on celebrations surrounding an "Ice Palace" built in St. Petersburg in the winter of 1740. A fine example of Leibnizian theatre, the Ice Palace mobilized artefacts and skills drawn from the Academy's



Kunstkammer to demonstrate Russia's new status as a civilized member of Western European nations, and identified the sciences as central to this project's success. Thus the Ice Palace, and St. Petersburg's scientific theatricals generally, make manifest the importance of spectacle for the dissemination of the sciences during the Enlightenment and can serve as a nexus in which to see clearly the interlinking of the sciences and absolutist political economy at this time.

Robert S. Westman *University of California, San Diego*

Kepler's Early Astrological Problematic

Important dimensions of Michael Maestlin's (1550-1631) role in framing Kepler's adoption of Copernicus's theory are now widely acknowledged and reasonably well understood. Also, thanks to recent scholarship, the general outline of Kepler's astrological ideas is reasonably well mapped. Rather less attention has been paid to how Maestlin's views helped to shape Kepler's attitude toward astrological theory and practice and how Kepler reconciled those views with his evolving cosmographical commitments. In this paper, I will suggest that Kepler's astrological, physical, and astronomical convictions were interwoven in significant ways from his early days as a student at Tübingen.

Elizabeth A. Williams *Oklahoma State University*

The Scientific Discourse of Hysteria in Enlightenment France

If hysteria has been largely discredited as a diagnostic category, nonetheless as a cultural phenomenon it draws ever more intense scrutiny from historians of science, medicine, and art as well as professionals in diverse mental health disciplines. In the historical literature devoted to hysteria, the eighteenth century has been consistently slighted despite the fact that Enlightenment medicine supplied crucial ingredients to modern thinking about hysteria, its nature, treatment, and general cultural significance. This historiographical lacuna, to which Mark Micale drew attention in 1989, has not been filled since, despite the appearance of valuable new work on hysteria in later periods. This paper will examine the status of hysteria in eighteenth-century French nosologies, especially the *Nosologie méthodique* of François Boissier de Sauvages, and in the specialized literature of the "vapors" produced between the 1750s and 1780s by Joseph Raulin, Pierre Pomme, Edme-Pierre Chauvot de Beauchêne, and others. Three problems will be emphasized: 1) the status of hysteria as somatic or psychodynamic in origin, and the variety of etiologies proposed within these broad domains of explanation 2) the place of hysteria as a nosological category in relation to closely-allied conditions such as hypochondria, melancholia, and, especially, the "vapors" that dominated

medical discussion in the late Enlightenment and 3) the “gendering” of hysteria in works produced in the 1780s, especially Beauchêne’s *De l’influence des affections de l’âme dans les maladies nerveuses des femmes*. The paper will stress the complexity of the discourse of hysteria in Enlightenment France while arguing that the late eighteenth century witnessed a general trend away from somatic explanation and toward holistic, psychosomatic explanations that depended heavily on emergent conceptions of strictly delimited gender roles. Thus it will be argued that the gendering of hysteria in the late Enlightenment emerged from a larger physiological and medical discourse that purportedly grounded pathological categories in a new understanding of the physico-moral constitution of the sexes.

Jack Wilson *Washington & Lee University*

U.S Patents on Organisms Prior to *Diamond v. Chakrabarty*

This paper explores the history of the interaction between intellectual property law and biology in the United States prior to the *Chakrabarty* decision. As is well known, in 1980 the U.S. Supreme Court ruled that patent statutes should be interpreted so as to include living bacteria within the scope of patent law. Contrary to popular opinion, however, the *Chakrabarty* case did not represent the first time that patent protection had been extended to an economically important living organism had been patented. Numerous process and product patents had previously been issued for bacteria, viruses, and vaccines. Some higher plants had been protected from unauthorized asexual reproduction through the Plant Patent Act of 1930. The scientific and political factors involved in these patents make an interesting story in their own right and also foreshadow the current debates about intellectual property rights covering genetically modified organisms and genes.

Alison Winter *California Institute of Technology*

Snails, Leeches, Mediums, and Conductors: The Use of Living Things as Instruments in Mid-Nineteenth Century Europe

The mid nineteenth century saw the proliferation of a number of very different experimental inventions that, despite their differences, shared one striking characteristic: the physiology of a living animal was joined to the working of a mechanical device to create a composite instrumental system. Four examples, falling within a single decade, are the so-called ‘snail telegraph’, in which snails were claimed to be able to transmit information between Paris and New York the ‘tempest prognosticator,’ which relied on the responses of leeches to an impending storm the fashionable practices of ‘table turning’ (the immediate precursor of

spiritualism in Europe) in which participants linked hands round a table in the expectation that combined nervous energy would make the table turn and the ‘electric baton’ of Hector Berlioz, in which the maestro created a telegraphic network linked to metronomes which, in turn, were attached to human ‘sou chefs’, to allow the varying beat of his baton to be communicated through simultaneously human and electric channels to a vast orchestra. In each of these varying scenarios, the living animal or human being is not only linked to a mechanical device but incorporated within it and the phenomena that link the animate to the inanimate parts of the experiment are thought to involve a simple reflex or the flow of nervous influence between the two entities. In this paper I will explore why these various enterprises developed as they did, and at the time that they did. I will use them to address the nature of experiment, its relation to human action and inter-relations, as the disciplines of modern experimental science came into being.

Audra J. Wolfe *University of Pennsylvania*

Protecting Turfs (Literally):

Negotiating the Meanings of Exobiology at the Dawn of the Space Age

The launch of Sputnik sparked the formation of numerous American scientific advisory boards on the topic of space science. While some of these dealt with technical questions on rocketry, scientists at the National Academy of Sciences, NASA, the President’s Scientific Advisory Council, and the military threw themselves into a topic generally known as “life science in space.” For the public this usually meant one of two things: man-in-space research (bioastronautics) or the search for extra-terrestrial life (exobiology). The Armed Forces/National Research Council on Bioastronautics and early NASA programs focused nearly exclusively on man-in-space, but Joshua Lederberg and an eager collection of West Coast geneticists, bacteriologists, biochemists, and chemists regarded interplanetary surface and atmospheric contamination as the most critical problem posed by the space program. This was the origin of the science of exobiology, loosely defined as the study of life outside of earth. My paper focuses on the rhetorical framework of exobiology established in these early discussions. Molecular knowledge legitimated exobiology as a “basic” science in opposition to the “applications” of the man-in-space research; simultaneously, containment and the concept of the alien ensured popular and political support for their Space Age science. Other elite biologists—especially those from naturalist evolutionary traditions—challenged the rhetorical devices and narrative strategies used by the exobiologists. Questioning exobiology’s legitimacy was a way to restate in Cold War terms the postwar debate on the character of biology as a holistic or reductionistic science. Exobiology could be regarded as either a step towards or a diversion from a positive experimental biology program in space. A careful examination of language used to discuss exobiology’s role in the space program will inform our understanding of the relationship between American scientists and the state in the Cold War era.

Andrea I. Woody *University of Washington*

Brodie's "Calculus": A Chemistry with No Future as Window onto the Past

Reporting on a 1867 lecture to the London Chemical Society, *The Chemical News* declared Sir Benjamin Brodie's—*Calculus of Chemical Operations*—"the chemistry of the future". The irony of the proclamation will be lost on no one familiar with the fast demise of Brodie's calculus. Though never adopted, the system illustrates vividly several issues confronting the chemical sciences in the late nineteenth century, including a self-conscious awareness that decisions made at this point in time would be crucial in determining the chemistry of the future. This talk explores certain interrelated aspects of Brodie's formalism, including 1) its explicit acknowledgment of the role of representation in shaping an intellectual enterprise's conceptual resources, 2) the assumption that such conceptions radically constrain the future development of the enterprise, 3) implicit articulation of the proper role of theory in chemical practice, and 4) the relevance of this issue for both assessing (and interpreting) atomic theory and understanding the value of abstract mathematical structure within science. From a historiographic perspective, Brodie's calculus is intriguing precisely because it was designed to address particular problems recognized by the chemical community yet was clearly infeasible in several important respects. Discussion of the calculus consequently forced to the surface metatheoretical and methodological assumptions which typically remain implicit in the public discourse of the period. For this reason, examination of Brodie's calculus may provide a window onto a landscape of self-conceptions—professional, social, epistemological, and methodological—that typically remains hidden.

Mary K. K. Yearl *Yale University*

The Time of Bloodletting

Four to ten times in a year, a mediaeval monk could request in chapter permission to be bled. Upon receiving a "bleeding licence," the monk would change into his night shoes and proceed to the infirmary where the cutting of a vein would be the start of a three-day event during which he was excused from monastic services, ate food of a higher quality than usual, and sometimes was even allowed to talk with the other *minuti*. At the end of the third day, the monk had to return to the chapter-house and beg for forgiveness with his face on the ground . . . implying that though medically necessary, the time of bloodletting also involved some sin on the part of the participants. What were the sins committed at the time of bloodletting such that *minuti* often had to do penance upon their return to the community? Was it the possibility that they had entertained impure thoughts? Was their sin that they had been excused

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from religious services for three days? Could it be the sin of having indulged in those foods—meat especially—that were normally prohibited? In my paper, I shall examine some of the dualities that characterize the time of bloodletting: how it was that this event was deemed medically necessary, while in some sense being emblematic of sin and how, if minuti had sinned, they also symbolized Christ, who (to use an image common at the time) had been phlebotomized on the cross to cure humanity of the sins of the five senses. I shall argue that the time of bloodletting is representative of broader debates about the place of physical medicine in Christianity, and that the compromises reached acknowledged the importance of medicine, while affirming the priority given to the religious life. Bloodletting itself was acknowledged to be a crucial part of maintaining health, but the times to bleed were dictated not by medical authority, but by the avoidance of disruption to monastic life. Thus, bleeding was forbidden not in extreme seasons or when the moon was waxing or even on Egyptian days, but near major feast days, or when there was a fast that could not be broken.

Richard Yeo *Griffith University, Brisbane, Australia*

A Solution to the Multitude of Books:

Ephraim Chambers' *Cyclopaedia* (1728) as “the Best Book in the Universe”

In making the audacious claim referred to in my title, Chambers was able to draw on an earlier intellectual and educational tradition—the Renaissance tradition of commonplaces and the practice of keeping commonplace books. He was also able to put this legacy to work in another context—the debates stimulated by the 1710 copyright Statute. This paper looks at two senses in which Chambers regarded and promoted his *Cyclopaedia* (2 vols, 1728): 1) as a scientific dictionary that promised to replace other books, condensing knowledge of the arts and sciences into two large folio volumes 2) as a work conceived as having a structure or design, planned by an author. Chambers faced contemporary anxieties about the explosion of books and new scientific discoveries by asserting that knowledge had to be reduced to essentials and collated in an accessible work. In stressing that this could be achieved in an alphabetical dictionary without losing a grasp of the circle of sciences and the integrity of individual subjects, he depended on an analogy with a commonplace book arranged under Heads. At the same time, this analogy reinforced his contention that dictionary makers were absolved of the charge of plagiarism because they collected knowledge from a range of sources as a public service. Moreover, by affirming that his work betrayed scholarly abridgement and conceptual design—again with allusions to the commonplace tradition—he defended it as one worthy of a copyright in a period in which the meaning of intellectual property was being fiercely contested.

Christian C. Young *Mount Angel Seminary*

American Wildlife Organizations in the Progressive Era

The emergence of concern for wildlife protection around the turn of the twentieth century corresponded with a growing insistence on scientific expertise. As a consequence, subsequent generations of biologists, game managers, and historians have generally considered wildlife protection a part of the Progressive Era nature conservation movement. While the connection between wildlife protection and American conservation may be undeniable, the standard interpretation of conservation as a Progressive Era movement deserves further examination given the relationship between scientific expertise and wildlife protection. In this paper, I examine that relationship, looking specifically at the way American wildlife organizations used Progressive Era rhetoric about science to promote greater participation for scientists in wildlife protection and policymaking. Scientists themselves often found themselves in the uncomfortable role of expert without any particular expertise. Rather than withdraw, however, scientists adopted an approach that has persisted in conservation and environmental controversies: they issued demands for further study. This served the dual purpose of justifying their initial involvement and ensuring their continued authority in debates over wildlife protection, even if they were not certain how scientific knowledge might contribute expertise. I will use a number of brief cases to illustrate this trend and suggest its centrality more generally in the notion of scientific expertise in conservation during the Progressive Era.

Suzanne Zeller *Wilfrid Laurier University*

Elective Affinities:

National Identity and Early Timber Researches at McGill University,
1894-1910

During the 1890s, McGill University became a centre for pioneering researches in forest sciences. An outgrowth in North America of tension between modern industry's voracious appetite for natural resources and a nascent public awareness of ecology and the need for conservation, forest sciences embraced a broad spectrum of subfields intertwining physics, chemistry, engineering, and biology. As they were practised at McGill, forest sciences invited cooperation primarily between faculty members from the Departments of Applied Science and Botany. Responses to their published work generated cross-border discussions with colleagues at American institutions, engaging national identities both directly and indirectly in complex permutations and combinations from at least 4 different perspectives: a British "empirical" engineering tradition in timber testing transplanted by McGill's dean of applied science, H. T. Bovey (1852-1912) a

European “theoretical” tradition in timber physics extolled by Bovey’s nemesis, B. E. Fernow (1851-1923), the Prussian-trained chief of the U.S. Division of Forestry a “progressive” evolutionary tradition in plant phylogeny extended by McGill’s American-born and -trained professor of botany, D.P. Penhallow (1854-1910) and a “reductionist” evolutionary revisionism introduced by Penhallow’s mirror image, E. C. Jeffrey (1866-1952), Harvard University’s Canadian-born and -trained plant morphologist. In shifting patterns reminiscent of Goethe’s *Elective Affinities*, the resulting exchanges and interchanges among representatives of these various perspectives highlight the historical relationship between science and nation as highly utilitarian, and contingent upon the broader context of its time.

Leila Zenderland *California State University, Fullerton*

Of Mice, Men, and Mercy Killing:
Steinbeck’s Novel and the Euthanasia Debate

John Steinbeck’s 1937 novel, *Of Mice and Men*, tells a tale of two murders. In the first, a mentally retarded farmhand named Lennie, a child-like man who likes to pet soft objects, accidentally strangles a woman. In the second, this man’s closest friend and protector, George, trying to spare Lennie from a lynch mob, shoots him in the back of the head—a murder committed out of love, the story suggests, a mercy killing. An immediate bestseller, by 1939 this story had also been transformed into an acclaimed Broadway play and a successful Hollywood film. In the following years, it has remained immensely popular more than six decades later, this novel is one of the most frequently taught literary texts in American high schools. This paper will reconsider Steinbeck’s popular story in light of several scientific, social, and political controversies of the 1930s. In particular, it will focus on the ways that the fictional murders committed by Lennie and George raised questions about three broad concerns that had increasingly captured the attention of both psychological scientists and the general public: the meaning of mental retardation, the nature of criminal responsibility, and the morality of mercy killing. This paper will explore the complex interconnections between psychological theories and popular beliefs by reexamining this influential work of fiction produced by John Steinbeck, a naturalist novelist whose writing simultaneously reflected scientific curiosity and contemporary political concerns. It will also analyze this story’s messages within the more specific context of the 1930s euthanasia debate—a debate that increasingly came to link ideas about mental retardation with the question of mercy killing.

Yaakov Zik *University of Haifa, Israel*

Beyond the Naked Eye

Historians of science commonly describe Kepler as the father of modern geometrical optics. Kepler clarified the foundation of optics and solved a series of problems that had confounded his predecessors: the problem of vision, the camera obscura and the geometrical theory of the telescope. Kepler's books on optics, *Ad Vitellionem Paralipomena* (1604), which is solidly based upon a medieval foundation and *Dioptrice* (1611) which is considered to be the first treatise in modern geometrical optics, are the mile stones of his optical work. However, careful analysis of related texts and events, will clearly show that something in the above description is missing. In 1604, while Kepler was working on the *Paralipomena*, he disparaged the telescope most vigorously. The first time Kepler understood the potential of this instrument as a scientific device was after he had read about Galileo's discoveries, published in the *Sidereus Nuncius* (March 1610). Kepler wrote the *Conversation with Galileo's Sidereal Messenger* (an answer to the *Sidereus Nuncius*) in April 1610 and from the way he described the construction of the telescope, it was clear that he had not understood the importance of the focal length ratio and how the magnification was determined. By the end of August 1610 he got a telescope, made by Galileo, with which he was able to see Jupiter and its satellites. In late September 1610 Kepler completed his *Dioptrice* (which was published in the beginning of 1611). The chronological course of events strongly suggests that Kepler's reading of *Sidereus Nuncius* was not enough for him to understand the optical principles of the telescope. Only after examining and employing a telescope made by Galileo, was Kepler able to exploit the technical details and to learn how it works. It appears that the whole story deserves a re-examination. On the one hand it seems that Galileo must have known something about the science of optics and that we have underestimated his knowledge at our peril. On the other hand Kepler needed the knowledge that Galileo had attained, as reflected by his inability to construct the telescope, much more than what historians of sciences have been willing to accept. In this paper I shall argue that there are more key figures in this story and that its various aspects have not been properly appreciated up to this very day. Moreover, most of the theoretical aspects regarding the phenomena of light, vision, and lens properties necessary for the construction of the telescope (with the exception of the law of refraction which is in any event not essential to our case), had been at hand even before the time when Kepler addressed himself seriously to optics. I shall claim that over and above the actual building of the telescope it was Galileo who put all the theoretical pieces together. In my paper, I shall present a few aspects of the claim that in Galileo one finds a fusion of practical and theoretical knowledge which is crucial for the construction of an instrument that is also a bearer of theory.

PSA FULL PROGRAM SCHEDULE**Thursday, 2 November****4:00 p.m.—6:30 p.m.**

Scientific Modeling (Symposium)	(Cypress)
Pragmatism and the Philosophy of Science (Symposium)	(Grouse)
Experimentation in Neuroscience (Symposium)	(Stanley)
Philosophy of Biology (Contributed Papers)	(King George)
Quantum Mechanics I (Contributed Papers)	(Seymour)
Jeffrey and Bayesian Epistemology (Symposium)	(Oxford Room)

Friday, 3 November**9:00 a.m.—11:45 a.m.**

Experiment and Confirmation (Contributed Papers)	(Brighton)
Error Statistics and Beyond (Symposium)	(Seymour)
Simplicity, Model Selection, and the Akaike Information Criterion (Symposium)	(Lord Byron)
Quantum Computation and Information (Symposium)	(Plaza Centre)
Theory-Ladenness and the Neurology of Perception (Contributed Papers)	(Grouse)
Evolutionary Theory (Contributed Papers)	(Cypress)

Friday, 3 November**12:00 p.m.—1:00 p.m.****Regency West****Business Meeting****Friday, 3 November****1:30 p.m.—3:10 p.m.**

Bayesian Methodology I (Contributed Papers)	(Oxford Room)
Foundations of Probability (Contributed Papers)	(Seymour)
Quantum Mechanics II (Contributed Papers)	(Grouse)
Causation and Causal Loops (Contributed Papers)	(Regency West)
Underdetermination of Theories (Contributed Papers)	(Stanley)
Statistical Mechanics (Contributed Papers)	(Cypress)

Friday, 3 November
3:30 p.m.—5:30 p.m.

- What is the Foundational Significance of Category Theory?
 (Symposium) **(Brighton)**
- New Perspectives on Scientific Rationality (Symposium) **(Seymour)**
- The Gauge Concept in Modern Physics (Symposium) **(Cypress)**
- Critical Aspects of the Dutch Book Argument
 (Symposium) **(Lord Byron)**
- Experimentation and the Evaluation of Evolutionary Theories
 (Symposium) **(Grouse)**
- Science and Values (Contributed Papers) **(Stanley)**

Friday, 3 November
6:00 p.m.—7:30 p.m.
(Regency West)

Awards, Announcements and Introduction
Richard Jeffrey, Princeton University

President's Address
Michael Friedman, Indiana University

“Kant, Kuhn, and the Rationality of Science”

Saturday, 4 November
9:00 a.m.—11:45 a.m.

- Simultaneity, Space, and Spacetime (Contributed Papers) **(Seymour)**
- Philosophy of Neuroscience: Current Issues and Meta-Considerations
 (Symposium) **(Grouse)**
- Science and Public Policy (Contributed Papers) **(Lord Byron)**
- Theory and Observation (Contributed Papers) **(Cypress)**
- Broad Theories and Human Behavior (Symposium) **(Stanley)**
- The Future of the Linnaean Hierarchy (Symposium) **(Oxford Room)**

Saturday, 4 November
12:00 p.m.—1:00 p.m.
(Peacock's Room)

Backstage at the Journal—Noretta Koertge

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Saturday, 4 November**1:30 p.m.—3:10 p.m.**

Science, Evidence, and Evidence-Based Medicine (Symposium)	(Stanley)
Reduction, Emergence, and Metaphysics (Contributed Papers)	(Lord Byron)
Individual and Group-Level Cognition (Contributed Papers)	(Oxford Room)
Quantum Mechanics, Relativity, and Field Theory (Contributed Papers)	(Cypress)
Deconstructing and/or Reconstructing the Gene: Theoretical and Practical Implications (Symposium)	(Grouse)

Saturday, 4 November**3:30 p.m.—5:30 p.m.**

Quantum Gravity (Contributed Papers)	(Cypress)
Formal Learning Theory in the Philosophy of Science (Symposium)	(Balmoral)
Mechanism: Explanation, Discovery, and Experimentation (Symposium)	(Grouse)
History and Philosophy of Science (Contributed Papers)	(Seymour)
Models and Analogy (Contributed Papers)	(Oxford Room)
Scientific Realism (Contributed Papers)	(Stanley)

RECEPTIONS**Thursday, 2 November****7:00 p.m.—9:00 p.m.****(Regency Centre)****Friday, 3 November****5:30 p.m.—7:30 p.m.****(Regency Foyer)****Saturday, 4 November****7:00 p.m.—8:00 p.m.****(Cash Bar)****(Regency Foyer)****10:30 p.m.—12:00 a.m.****Graduate Student Party****(Regency Foyer)**

PSA 2000 PROGRAM

Thursday, 2 November

4:00 p.m.—6:30 p.m.

Scientific Modeling (Symposium)

(Cypress)

Paul Humphreys, *University of Virginia*, Theories, Experiments, and Computational Models

Andrea I. Woody, *University of Washington*, Representation and Reasoning: Making Sense of Modeling in Science

William C. Wimsatt, *University of Chicago*, The Use of False Models to Elaborate Constraints on Processes: the Case of Blending Inheritance

Robert Batterman, *Ohio State University*, Asymptotics and the Role of Minimal Models

CHAIR: Margaret Morrison, University of Toronto

Pragmatism and the Philosophy of Science (Symposium)

(Grouse)

Elisabeth A. Lloyd, *Indiana University*, C. S. Peirce on Scientific Method

Peter Godfrey-Smith, *Stanford University*, John Dewey's Philosophy of Science

Gary Hardcastle, *University of Wisconsin*, C. I. Lewis' A Priori

Alan W. Richardson, *University of British Columbia*, Philosophy of Science as Social Philosophy: American Pragmatism in the 1930s

CHAIR: P. Kyle Stanford, University of California, Irvine

Experimentation in Neuroscience (Symposium)

(Stanley)

William Bechtel, *Washington University, St. Louis*, Establishing Consilience Between Multiple Experimental Models

Jim Bogen, *University of Pittsburgh*, Some Epistemic Virtues of Functional Images of the Working Brain

Valerie Gray Hardcastle, *Virginia Polytechnic Institute and State University*, What Do the Data Really Show? Connecting Data with Hypotheses

Carl F. Craver, *Florida International University*, Interlevel Experiments, Multilevel Mechanisms, and Robustness

CHAIR: Richard M. Burian, Virginia Polytechnic Institute and State University

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Thursday, 2 November
4:00 p.m.—6:30 p.m.

Philosophy of Biology (Contributed Papers)
(King George)

Kim Cuddington, *University of Guelph / University of Connecticut*, The Balance of Nature metaphor in Population Ecology: Theory or Paradigm?

Anya Plutynski, *University of Pennsylvania*, Modeling Evolution in Theory and Practice

Rachel A. Ankeny, *University of Sydney*, Model Organisms as Cases: Understanding the ‘Lingua Franca’ at the Heart of the Human Genome Project

William A. Rottschaefer, *Lewis and Clark College*, The Scientific Naturalization of Ethics

CHAIR: Bruce Glymour, Kansas State University

Quantum Mechanics I (Contributed Papers)
(Seymour)

Michael Dickson, *Indiana University*, Quantum Logic is Alive (and it is true or it is false)

Ruth E. Kastner, *University of Maryland*, A critical look at time-symmetric quantum counterfactuals

Armond Duwell, *University of Pittsburgh*, Explaining Information Transfer in Quantum Teleportation

CHAIR: Frank Arntzenius, Rutgers University

Jeffrey and Bayesian Epistemology (Symposium)
(Oxford Room)

Persi Diaconis, *Stanford University*, Probability Kinematics at the Millennium

Sandy Zabell, *Northwestern University*, Finite Additivity and Radical Probabilism

Brian Skyrms, *University of California, Irvine*, Altruism, Inclusive Fitness, and ‘The Logic of Decision’

CHAIR: Carl G. Wagner, University of Tennessee, Knoxville

Friday, 3 November
9:00 a.m.—11:45 a.m.

Experiment and Confirmation (Contributed Papers)
(Brighton)

Michelle Little, *Northwestern University*, Rethinking ‘Experimentation’

Samuel Mitchell, *Mt. Holyoke College*, Confirming Theories One Claim at a Time

Don Fallis, *University of Arizona*, Measures of Epistemic Utility and the Value of Experiments

Marc Lange, *University of Washington*, The Apparent Superiority of Prediction To Accommodation As A Side Effect: A Reply to Maher

CHAIR: Jason Alexander, University of California, San Diego

Error Statistics and Beyond (Symposium)
(Seymour)

Kent W. Staley, *Arkansas State University*, What Experiment Did We Just Do?: Counterfactual Error Statistics and Uncertainties about the Reference Class

Peter J. Lewis, *University of Miami*, In Which Error Statistics Rescues Realism from the Pessimistic Induction

Cassandra L. Pinnick, *Western Kentucky University*, Error and Underdetermination: The Status of Metamethodology

Douglas Allchin, *University of Minnesota*, The Epistemology of Error

COMMENTARY: Deborah Mayo, *Virginia Polytechnic Institute and State University*, Towards an Error Statistical Philosophy of Science

CHAIR: Henry E. Kyburg Jr., University of Rochester

Simplicity, Model Selection, and the Akaike Information Criterion
(Symposium)
(Lord Byron)

Elliott Sober, *University of Wisconsin*, What Does the Akaike Framework Tell us about Empiricism and Scientific Realism?

Malcolm R. Forster, *University of Wisconsin*, The Akaike Information Criterion Compared to Other Methods of Inference

William Harper, *University of Western Ontario* and **Wayne C. Myrvold**, *University of Western Ontario*, Simplicity and Scientific Inference

CHAIR: I. A. Kieseppa, University of Helsinki

Quantum Computation and Information (Symposium)
(Plaza Centre)

Rob Clifton, *University of Pittsburgh*, Nonlocality and Entanglement in Quantum Information Theory

David MacCallum, *Carleton College*, Quantum Entanglement and Classical Computation

Itamar Pitowsky, *Hebrew University, Jerusalem*, Quantum Speed-up of Computations

Jeffrey Bub, *University of Maryland, College Park*, Quantum Cryptography

CHAIRS: Jeffrey Bub, University of Maryland, College Park and David MacCallum, Carleton College

Friday, 3 November
9:00 a.m.—11:45 a.m.

Theory-Ladenness and the Neurology of Perception (Contributed Papers)
(Grouse)

Athanasios Raftopoulos, *University of Cyprus*, Reentrant Neural Pathways and the Theory-Ladenness of Perception

Patrick J. McDonald, *University of Notre Dame*, Simulation by Demonstration: The Central Place of Experiment in Helmholtz's Theory of Perception

William F. Brewer, *University of Illinois, Urbana, Champaign* and **Bruce L. Lambert**, *University of Illinois, Chicago*, The Theory-Ladenness of Observation and the Theory-Ladenness of the Rest of the Scientific Process

Xiang Chen, *California Lutheran University*, Perceptual Symbols and Taxonomy Comparison

CHAIR: Peter Barker, University of Oklahoma

Evolutionary Theory (Contributed Papers)
(Cypress)

Carla Fehr, *Iowa State University*, The Evolution of Sexual Reproduction: Pluralism that is More than a Pragmatic Issue

Marcel Weber, *Universitat Hannover*, Determinism, Realism, and Probability in Evolutionary Theory: the Pitfalls, and How to Avoid Them

Roberta L. Millstein, *California State University, Hayward*, Is the Evolutionary Process Deterministic or Indeterministic? An Argument for Agnosticism

Robert C. Richardson, *University of Cincinnati*, Chance and Indeterminism in Evolutionary Explanation

CHAIR: Sandra Mitchell, University of Pittsburgh

Friday, 3 November
12:00 p.m.—1:00 p.m.: Business Meeting

Friday, 3 November
1:30 p.m.—3:10 p.m.

Bayesian Methodology I (Contributed Papers)
(Oxford Room)

Carl G. Wagner, *University of Tennessee*, Old Evidence and New Explanation III
I. A. Kieseppa, *University of Helsinki*, Statistical Model Selection Criteria and Bayesianism

Tetsuji Iseda, *Nagoya University*, Bridging a Gap Between Naturalistic and Traditional Approaches in the Philosophy of Science

CHAIR: Allan Franklin, University of Colorado

Foundations of Probability (Contributed Papers)

(Seymour)

John T. Roberts, *University of North Carolina, Chapel Hill*, Undermining Undermined: Why Humean Supervenience Never Needed to be Debugged (Even If It's a Necessary Truth)

Paul Bartha, *University of British Columbia* and **Richard Johns**, *University of British Columbia*, Probability and Symmetry

Marshall Abrams, *University of Chicago*, Short-Run Mechanistic Probability
CHAIR: Paul Humphreys, University of Virginia

Quantum Mechanics II (Contributed Papers)

(Grouse)

Bradley Monton, *University of Kentucky*, On Dualistic Interpretations of Quantum Mechanics

Christopher Lehner, *California Institute of Technology*, Which Way Does It Cut? Ockham's Razor in No-Collapse Interpretations

CHAIR: Meir Hemmo, University of Haifa, Israel

Causation and Causal Loops (Contributed Papers)

(Regency West)

Daniel M. Hausman, *University of Wisconsin*, Causal Relations Among Tokens, Types, and Variables

Phil Dowe, *University of Tasmania*, Causal Loops and the Independence of Causal Facts

Joseph Berkovitz, *London School of Economics*, Causal Loops in Quantum Phenomena?

CHAIR: Mauricio Suarez, University of Bristol

Underdetermination of Theories (Contributed Papers)

(Stanley)

Alberto Cordero, *Queens College and The Graduate Center, CUNY*, Realism and Underdetermination: Some Clues From the Practices-Up

P. Kyle Stanford, *University of California, Irvine*, Refusing the Devil's Bargain: What Kind of Underdetermination Should We Take Seriously?

Otavio Bueno, *California State University, Fresno*, Application of Mathematics and Underdetermination

CHAIR: Richard Healey, University of Arizona



Friday, 3 November
1:30 p.m.—3:10 p.m.

Statistical Mechanics (Contributed Papers)
(Cypress)

Adam Elga, *Massachusetts Institute of Technology*, Statistical Mechanics and the Asymmetry of Counterfactual Dependence

Chuang Liu, *University of Florida*, Infinite Systems in SM Explanations: Thermodynamic Limit, Renormalization (semi-) Group, and Irreversibility

James Guszcza, On the Information Theoretic Approach to Statistical Mechanics

CHAIR: Andrew Wayne, Concordia University

Friday, 3 November
3:30 p.m.—5:30 p.m.

What is the Foundational Significance of Category Theory? (Symposium)
(Brighton)

Jean-Pierre Marquis, *Universite de Montreal*, Category Theory: From the Fundamentals to the Foundations

Steven Awodey, *Carnegie Mellon University*, Continuity and Logical Completeness: An Application of Topos Theory

CHAIR: Elaine Landry; Sub-Faculty of Philosophy, Wolfson College, Oxford University

New Perspectives on Scientific Rationality (Symposium)
(Seymour)

Robyn M. Dawes, *Carnegie Mellon University*, The Ethics of Using or Not Using Statistical Prediction Rules in Psychological Practice and Related Consulting Activities

David Faust, *University of Rhode Island*, Using Meta-Scientific Studies to Clarify or Resolve Questions in the Philosophy and History of Science

Michael Bishop, *Iowa State University* and **J. D. Trout**, *Loyola University of Chicago*, 50 Years of Successful Predictive Modeling Should be Enough: Lessons for Philosophy of Science

CHAIR: Dominic Murphy, California Institute of Technology

The Gauge Concept in Modern Physics (Symposium)
(Cypress)

John Earman, *University of Pittsburgh*, Gauge Matters

Christopher Martin, *University of Pittsburgh*, The Gauge Argument

Gordon Belot, *New York University*, Gauging Out

COMMENTATOR and Chair: Tim Maudlin, Rutgers University

Critical Aspects of the Dutch Book Argument (Symposium)
(Lord Byron)

Henry E. Kyburg Jr., *University of Rochester*, The Dutch Book Argument and Rational Belief

Isaac Levi, *Columbia University*, Money Pumps and Diachronic Dutch Books

T. Seidenfeld, *Carnegie Mellon University*, **M. J. Schervish**, *Carnegie Mellon University*, and **J. B. Kadane**, *Carnegie Mellon University*, Degrees of Incoherence Applied to Statistical Hypothesis Testing at a Fixed Level

Chair: Teddy Seidenfeld, Carnegie Mellon University

Experimentation and the Evaluation of Evolutionary Theories (Symposium)
(Grouse)

Robert A. Skipper, Jr., *Oregon State University*, Strategies for Hypothesis Assessment in Evolutionary Biology

David Wyss Rudge, *Western Michigan University*, Kettlewell from an Error Statistician's Point of View

Robert N. Brandon, *Duke University*, Hypothetico-deductivism in the Philosophy of Biology: Away from Popper and back to Bernard

COMMENTATOR: Michael J. Wade, Indiana University

CHAIR: Elisabeth A. Lloyd, Indiana University

Science and Values (Contributed Papers)
(Stanley)

K. Brad Wray, *University of British Columbia*, Science, Biases, and the Threat of Global Pessimism

Kristina Rolin, *Helsinki School of Economics and Business Administration*, Rational Grounds for Trust in Science

Kristen Intemann, *University of Washington*, Science and Values: Are Value Judgements Always Irrelevant to the Justification of Scientific Claims?

CHAIR: Phyllis Rooney, Oakland University

Friday, 3 November
6:00 p.m.—7:30 p.m.
(Regency West)

Awards, Announcements and Introduction

Richard Jeffrey, *Princeton University*

President's Address

Michael Friedman, *Indiana University*

"Kant, Kuhn, and the Rationality of Science"

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Saturday, 4 November

9:00 a.m.—11:45 a.m.

Simultaneity, Space, and Spacetime (Contributed Papers)
(Seymour)

Robert Rynasiewicz, *Johns Hopkins University*, Definition, Convention, and Simultaneity: Malament's Result and Its Alleged Refutation by Sarkar and Stachel
Steve Weinstein, *Princeton University*, Remarks on the Conventionality of Simultaneity

Thomas Mormann, *Universidad del Pais Vasco*, A Quasianalytical Constitution of Physical Space

Mauro Dorato, *University of Rome III, Italy*, On Becoming, Cosmic Time and Rotating Universes

Glenn Parsons, *University of Alberta* and **Patrick McGivern**, *University of Alberta*, Can the Bundle Theory save Substantivalism from the Hole Argument?

CHAIR: David Malament, University of California, Irvine

Philosophy of Neuroscience: Current Issues and Meta-Considerations
(Symposium)
(Grouse)

Kathleen Akins, *Simon Fraser University*, Recent Work in the Neuroscience of Vision: Some Philosophical Considerations

Murat Aydede, *University of Chicago* and **Güven Guzeldere**, *Duke University*, Explaining Pain Experience in an Information-Theoretic Framework: Introspective Mechanisms and Concept Formation

Owen Flanagan, *Duke University*, Is the Neural Level Privileged in the Explanation of the Mental?

COMMENTATOR: Patricia Churchland, University of California, San Diego

CHAIR: Güven Guzeldere, Duke University

Science and Public Policy (Contributed Papers)
(Lord Byron)

Kristin Shrader-Frechette, *University of Notre Dame*, Radiobiological Hormesis, Methodological Value Judgments, and Metascience

Kevin Elliott, *University of Notre Dame*, Chemical Hormesis: Assessing the Warrant for Policy-Driven Science

Lisa Gannett, *California State University, Chico*, Racism and Human Genome Diversity Research: the Ethical Limits of 'Population Thinking'

Jay Odenbaugh, *University of Calgary*, Ecological Stability, Model Building, and Environmental Policy: A Reply to Some of the Pessimism

CHAIR: Peter Kirschenmann, Vrije Universiteit Amsterdam

Theory and Observation (Contributed Papers)

(Cypress)

Eric R. Scerri, *University of California, Los Angeles*, The Recently Claimed Observation of Atomic Orbitals and Some Related Philosophical Issues

Ronald N. Giere, *University of Minnesota*, The Perspectival Nature of Scientific Observation

Robert G. Hudson, *Algoma University College*, Evaluating Background Independence

Hans Radder, *Vrije University*, Primitive Rays and Aetherial Air: On the Impossibility of Theory-Free Experiments

CHAIR: Sherrilyn Roush, Harvard University

Broad Theories and Human Behavior (Symposium)

(Stanley)

John Dupre, *University of London*, The Lure of the Simplistic

Alison Wylie, *Washington University, St. Louis*, The Scope of Models of Cultural Process

Jonathan Michael Kaplan, *University of Tennessee, Knoxville*, Phylogenetic Information and Human Adaptations

Helen Longino, *University of Minnesota*, Individualism and Folk Psychology in the Biology of Aggression

Massimo Pigliucci, *University of Tennessee, Knoxville*, Genotype-Environment Interactions and our Understanding of the Biological Bases of Human Cognitive Abilities

CHAIR: Jonathan Kaplan, University of Tennessee, Knoxville

The Future of the Linnaean Hierarchy (Symposium)

(Oxford Room)

David Hull, *Northwestern University*, A Deceptive Illusion: Classifying Trees

Kevin de Quieroz, *National Museum of Natural History, Smithsonian Institute*, The Linnaean Hierarchy and its conflicts with the Principle of Evolution

Michael J. Donoghue, *Yale University*, Abandoning Taxonomic Ranks

Marc Ereshefsky, *University of Calgary*, Linnaean Ranks: Vestiges of a Bygone Era

CHAIR: Elliott Sober, University of Wisconsin, Madison

Saturday, 4 November

12:00 p.m.—1:00 p.m.

(Peacock's Room)

Backstage at the Journal—Noretta Koertge

Designed primarily for graduate students and others new to academic publishing, this informal session will provide an opportunity to chat with members of the Editorial Staff and Editorial Board of *Philosophy of Science*.

Saturday, 4 November
1:30 p.m.—3:10 p.m.

Bayesian Methodology II (Contributed Papers)
(Seymour)

Branden Fitelson, *University of Wisconsin, Madison*, A Bayesian Account of Independent Evidence With Applications

Daniel Steel, *University of Pittsburgh*, Bayesian Statistics in Radiocarbon Calibration

Michael B. Kruse, *Virginia Polytechnic Institute and State University*, Are There Bayesian Success Stories? The Case of the Raven's Paradox

CHAIR: Christopher Hitchcock, California Institute of Technology

Science, Evidence, and Evidence-Based Medicine (Symposium)
(Stanley)

Brian Haynes, *McMaster University*, What Kind of Evidence is it that Evidence-Based Medicine Advocates Want Patients, Practitioners, Policy Makers and the Public to Pay Attention To?

John Worrall, *London School of Economics*, What Evidence in Evidence-Based Medicine? (Extended outline)

Kenneth Schaffner, *George Washington University*, The Implications of EBM for Disunity of Science Philosophy of Science

CHAIR: Clark Glymour, Carnegie Mellon University

Reduction, Emergence, and Metaphysics (Contributed Papers)
(Lord Byron)

Christopher Eliot, *University of Minnesota*, A Field Guide to Reductionism in Ecology

Bryon Cunningham, *Emory University*, The Reemergence of 'Emergence'

Sergio Sismondo, *Queen's University* and **Nicholas Chrisman**, *University of Washington*, Deflationary Metaphysics and the Natures of Maps

CHAIR: Jane Duran, University of California, Santa Barbara

Individual and Group-Level Cognition (Contributed Papers)
(Oxford Room)

Wayne Christensen, *University of Newcastle* and **C. A. Hooker**, *University of Newcastle*, Self-Directed Anticipative Learning Processes in Science

Robert A. Wilson, *University of Alberta*, Group-Level Cognition

CHAIR: Mathias Frisch, Northwestern University

Quantum Mechanics, Relativity, and Field Theory (Contributed Papers)
(Cypress)

Holger Lyre, *Ruhr, Universitat Bochum*, The Principles of Gauging

Wayne C. Myrvold, *University of Western Ontario*, Einstein's Untimely Burial

Frederick M. Kronz, *University of Texas, Austin*, Philosophical Aspects of Algebraic Quantum Theory

CHAIR: Robert Bishop, IGPP, Freiburg, Germany

**Deconstructing and/or Reconstructing the Gene:
Theoretical and Practical Implications (Symposium)**

(Grouse)

David Magnus, *University of Pennsylvania*, Conceptual Ambiguities in the Concept of a Gene

C. Kenneth Waters, *University of Minnesota*, The Gene-Centered Point of View

Lenny Moss, *University of Notre Dame*, Is it Gene-P or Gene-D? That is the Question

COMMENTATOR: Peter Godfrey-Smith, *Stanford University*

CHAIR: Stephen M. Downes, *University of Utah*

Saturday, 4 November

3:30 p.m.—5:30 p.m.

Quantum Gravity (Contributed Papers)

(Cypress)

James Mattingly, *Indiana University*, Singularities and Scalar Fields. Matter Theory and General Relativity

Craig Callender, *London School of Economics* and **Nick Huggett**, *University of Illinois, Chicago*, Why Quantize Gravity (Or Any Other Field For That Matter)?

Peter Bokulich, *University of Notre Dame*, Black Hole Remnants and Classical vs. Quantum Gravity

Erik Curiel, *Stanford University*, Against the Excesses of Quantum Gravity: A Plea for Modesty

CHAIR: John D. Norton, *University of Pittsburgh*

Formal Learning Theory in the Philosophy of Science (Symposium)

(Balmoral)

Daniel Osherson, *Rice University* and **Eric Martin**, *University of New South Wales*, Scientific Discovery from the Perspective of Hypothesis Acceptance

Kevin T. Kelly, *Carnegie Mellon University*, Revolution, Revision, Regress, and Reliability

Oliver Schulte, *University of Alberta*, Inferring Conservation Principles in Particle Physics: A Case Study in Reliable and Efficient Inquiry

CHAIR: Clark Glymour, *Carnegie Mellon University*

Mechanism: Explanation, Discovery, and Experimentation (Symposium)

(Grouse)

Stuart Glennan, *Butler University*, Rethinking Mechanistic Explanation”

Lindley Darden, *University of Maryland, College Park*, Strategies for Discovering Mechanisms”

Sylvia Culp, *Western Michigan University*, Evaluating the Use of Experiments in Constructing and Testing Mechanism Schemata”

COMMENTATOR: **Jim Woodward**, *California Institute of Technology*, Mechanisms and Causality

CHAIR: Noretta Koertge, *Indiana University*



Saturday, 4 November

3:30 p.m.—5:30 p.m.

History and Philosophy of Science (Contributed Papers)
(Seymour)

Oswaldo Pessoa Jr., *Federal University of Bahia, Brazil*, Counterfactual Histories: The Beginning of Quantum Physics (Figure 1) (Figure 2)

Theodore Arabatzis, *Massachusetts Institute of Technology and University of Athens*, Can a Historian of Science be a Scientific Realist?

Edward Slowik, *Winona State University*, Descartes' Science, Holism, and the Mechanical Philosophy

Alex Viskovatoff, *University of Pittsburgh*, Economics and Kant's Philosophy of Science

CHAIR: Richard Grandy, Rice University

Models and Analogy (Contributed Papers)
(Oxford Room)

Alisa N. Bokulich, *University of Notre Dame*, Maps, Models, and Quantum Chaos

Eric Winsberg, *Northwestern University*, Simulations, Models, and Theories: Complex Physical Systems and their Representations

R. I. G. Hughes, *University of South Carolina*, Conceptual Change and the DDI Account of Theoretical Representation

Stephen H. Kellert, *Hamline University and The Minnesota Center for Philosophy of Science*, Extrascientific Uses of Physics: the case of Nonlinear Dynamics and Chaos Theory

CHAIR: Paul Teller, University of California, Davis

Scientific Realism (Contributed Papers)
(Stanley)

James K. Derden Jr., *Humboldt State University*, A Different Conception of Scientific Realism: The Case of the Missing Explanandum

Stathis Psillos, *University of Athens*, Is Structural Realism Possible?

Robin Findlay Hendry, *University of Durham*, Are Realism and Instrumentalism Methodologically Indifferent?

Hanne Andersen, *University of Copenhagen*, Reference and Resemblance

CHAIR: Ian Hacking, University of Toronto

PSA ABSTRACTS

The following abstracts for PSA sessions appear as they were submitted, with some minor exceptions. Due to space limitations, paragraph breaks within each abstract were eliminated. Also, some submissions were difficult to read and some words may have been inadvertently altered. To promote accuracy, the abstracts were posted on the society's Web site, and authors were encouraged to check that their original wording survived intact. The varying length of the abstracts is due to the fact that some authors exceeded the space allotted on the paper proposal form. Authors were encouraged to limit their abstracts to **250 words or less**. We thank the organizers, presenters, commentators, and all those involved whose work ensures the success of the annual meeting.

Marshall Abrams *University of Chicago*

Short-Run Mechanistic Probability

This paper sketches a concept of higher-level objective probability ("short-run mechanistic probability", SRMP) inspired partly by a style of explanation of relative frequencies known as the "method of arbitrary functions". SRMP has the potential to fulfil the need for a theory of objective probability which has wide application at higher levels and which gives probability causal connections to observed relative frequency (without making it equivalent to relative frequency). Though this approach provides probabilities on a space of event types, it does not provide probabilities for outcomes on particular trials. This allows SRMP to coexist with lower-level probabilities that do govern individual trials.

Kathleen Akins *Simon Fraser University*

Recent Work in the Neuroscience of Vision: Some Philosophical Implications

A good deal of recent work on vision is re-shaping the traditional conception of visual processing as providing, as Marr said, the "what and where" of the visual world. I will present a few of these new results in the fields of colour vision, attention, and visually-guided behaviour, results which provide interesting case studies for our philosophical theories of representational content and perceptual experience.

Douglas Allchin *University of Minnesota*

The Epistemology of Error

How do we know and justify that a scientist has erred? Through several case studies, including the recently contested case of bacterial mesosomes (Rasmussen 1993, Culp 1994, and Hudson 1999), I examine the epistemic work in ascertaining error, and the role of this reasoning in establishing reliable claims in each respective field. By focusing on the justification of error claims, one finds that an 'artifact' (a result attributable to an experimental procedure only) is a type of 'fact'. Thus, the characterization of experiment as separating fact from artifact (as highlighted by Hacking and Galison) is incomplete. As a remedy, I suggest strategies for achieving what I call 'deep reliability'. Historical occurrences of error (illustrated in these cases) show the importance of actively probing for error, beyond merely confirming theoretical maps through positive instances or evidence. When combined with Mayo's framework for error statistics, this suggests a broader philosophical research programme for developing Error Analytics as a branch of experimental reasoning.

Hanne Andersen *Dahum Institute*

Reference and Resemblance

Many discussions between realists and non-realists have centered on the issue of reference, especially whether there is referential stability during theory change. In this paper, I shall summarize the debate, sketching the problems which remain within the two opposing positions and show that both have ended on their own slippery slope, sliding away from their original position towards that of their opponents. Thus, in the search for a viable intermediate position, I shall suggest an account of reference which may follow the causal theory in explaining reference as carving the world at its joints but contrary to the causal theory this world is a phenomenal world whose variable joints exist only in a historical process in which they are transmitted gradually from one generation to the next. According to this account, the joints of a phenomenal world are constituted by family resemblance. I shall argue that on this account, bundles of features that span bounded areas in perceptual space underlie the joints of a phenomenal world. Further, the integrity of the cognitive process by which the cognitive process by which these joints are recognized recognizes these joints depends on a transmission process by which new generations are presented with given joints and bundles by the preceding generation. However, contrary to a traditional realist account, this heritage from the preceding generation may be transformed into new joints and bundles before transmission to new generations. This permits a continuous process of referential change in which the joints and bundles at different stages in the development of a theory can be connected by chains-of-reasoning.

Rachel A. Ankeny *University of Sydney*

Model Organisms as Cases: Understanding the ‘Lingua Franca’ at the Heart of the Human Genome Project

Through an examination of research in the Human Genome Project, it is argued the reasoning underlying the model organism program is best understood as case-based, analogical reasoning beginning from idealized, descriptive models, rather than as reasoning via causal analog models. This conceptualization of the role of model organisms should guide our understanding and assessment of these research programs, their knowledge claims and progress, and their limitations, as well as how we educate the public about this type of biomedical research.

Theodore Arabatzis *University of Athens*

Can a Historian of Science be a Scientific Realist?

In this paper I want to address the problems that the historical development of science poses for a realist and to discuss whether a realist construal of scientific activity is conducive to historiographical practice. My aim is to show that the realism problem is relevant to historiography and that the position one adopts with respect to this problem entails a particular historiographical strategy. I will argue that for historiographical purposes an agnostic attitude with respect to scientific theories and unobservable entities is the most appropriate.

Murat Aydede *The University of Chicago*

Güven Guzeldere *Duke University*

Explaining Pain Experience in an Information-Theoretic Framework:
Introspective Mechanisms And Concept Formation

There is a significant sense in which the neuroscience literature on pain suggests that what the basic pain researcher investigates is not pain itself, which is “always subjective”, but rather its most “proximate physical cause,” which is always objective. In fact, this dilemma is not peculiar to pain research but characteristic of neuroscientific research in general. We argue that the need for this kind of *prima facie* dualistic language arises out of a radical epistemic asymmetry in accessing the subject matter, rather than an indication of a dualist ontology. By drawing on recent scientific results we show how the phenomenology of pain experience can be handled in an ontologically unified way that remains monistic (physicalist). In particular, we argue that pain states are informational states to the core, and their affective dimensions can be treated within a psychofunctionalist framework. Finally, in order to account

for the epistemic asymmetry and address what appears to be a foundational problem, we introduce distinct introspective mechanisms that are tied to concept formation systems on the basis of sensory/affective information entry.

Steven Awodey *Carnegie Mellon University*

Continuity and Logical Completeness: An Application of Topos Theory

The notion of a continuously variable quantity can be regarded as a generalization of that of a particular (constant) quantity, and the properties of such quantities are then akin to, and derived from, the properties of constants. For example, the continuous, Real-valued functions on a topological space behave like the field of real numbers in many ways, but instead form a ring. Topos theory permits one to apply this same idea to logic, and to consider continuously variable sets (sheaves). In this talk, such applications to logic are explained and made accessible to the non-specialist. Some recent results in topos theory are then discussed in this setting, and it is shown how some new and powerful logical completeness theorems for systems of higher-order logic result.

Paul Bartha *University of British Columbia*
Richard Johns *University of British Columbia*

Probability and Symmetry

The Principle of Indifference, which dictates that we ought to assign two outcomes equal probability in the absence of known reasons to do otherwise, is vulnerable to well-known objections. Nevertheless, the appeal of the principle, and of symmetry-based assignments of equal probability, persists. We show that, relative to a given class of symmetries satisfying certain properties, we are justified in calling certain outcomes equally probable, and more generally, in defining what we call relative probabilities. Relative probabilities are useful in providing a generalized approach to conditionalization. The technique is illustrated by application to simple examples.

Joseph Berkovitz *The London School of Economics and Political Science*

Causal Loops in Quantum Phenomena?

A common view has it that there is a tension between quantum phenomena and the special theory of relativity. Yet, an ongoing debate concerning the prospects of relativistic quantum theories persists. In this paper, I consider two recent arguments for the impossibility of certain relativistic quantum

theories, due to Arntzenius (1994) and Maudlin (1994). The main idea of both arguments is that if these theories were possible, causal loops would also be. But, it is argued, the consistency conditions of such loops would exclude the very possibility of these theories. I argue that Arntzenius and Maudlin's lines of reasoning fail because they rely on untenable assumptions about the nature of probabilities in causal loops.

Michael Bishop *Iowa State University*
J. D. Trout *Loyola University of Chicago*

50 Years of Successful Predictive Modeling Should be Enough:
 Lessons for Philosophy of Science

This paper has two aims. The first is to describe a line of research that we believe philosophers have for too long ignored or not properly appreciated. The second is to extract some implications from this research for philosophy of science. In his classic 1954 book, Paul Meehl reported on 20 experiments in which human experts (clinical prediction) and actuarial formulas (a prediction is arrived at by a straightforward application of an equation to the data) made a prediction about a social phenomenon. Meehl found that in every non-ambiguous case, when both types of prediction were based on the same evidence, the actuarial predictions were more reliable. Since then, the evidence has expanded in three directions. First, every fair test since 1954 on a problem of social prediction has supported Meehl's conclusion. Second, giving human experts the "advantage" of certain kinds of information (e.g., unstructured interviews) typically degrades their reliability, and so doesn't help experts beat the formulas. And third, certain very simple, improper predictive models (models that are not constructed so as to best fit a large set of data) are also more reliable on problems of social predictions than human experts. (In fact, there is new and highly suggestive research in the area of "fast and frugal" heuristics indicating that in real world environments, there are extremely simple heuristics that consistently are about as reliable as computationally expensive, ideal models, such as multiple regression and Bayesian models.) The implications of these findings range from the concrete (how should we make predictions about whether a prisoner will commit violent crimes if paroled?) to the rarified (what is the nature of scientific rationality?). We will comment on three of the more rarified implications. Theories of scientific reasoning / rationality. A result of these findings is that for some problems of scientific reasoning, the most reliable, tractable reasoning strategy available to a scientist will be profoundly counterintuitive, violating some deeply held principles of rational enquiry. Some views of how scientists ought to reason are incompatible with the contention that scientists ought to use improper predictive models. Explanation. One reason people seem to prefer clinical predictions to actuarial predictions is that the former seems to provide more satisfying explanations. But given the often limping narrative causal descriptions that pass

for explanations, perhaps we should consider whether our preference for theories that are explanatory says more about our own intellectual addiction to causal narratives than it does about the epistemic importance of explanation. How to do philosophy of science. Philosophers of science typically use episodes in the history of science as evidence in their disputes about the nature of theory evaluation and theory selection. As Faust argues, this method exhibits many of the same frailties as the regrettable practice of expert, human (“clinical”) judgment in complex scientific domains. Should philosophers of science embrace actuarial methods in their research? An actuarial approach to the history and philosophy of science would draw upon scientific findings and could be evaluated by empirical means. This poses a dilemma for naturalistic philosophers of science: Either we reject the actuarial results and thereby reject the most reliable methods we have of coming to grips with complex phenomena, or we embrace the actuarial findings, in which case we seem forced to jettison considerable chunks of contemporary philosophy of science.

Peter Bokulich *University of Notre Dame*

Black Hole Remnants and Classical vs. Quantum Gravity

Belot, Earman, and Ruetsche (1999) dismiss the black hole remnant proposal as an inadequate response to the information loss paradox. I argue that their criticisms are misplaced and that, properly understood, remnants do offer a satisfying response to Hawking’s argument. I also claim that a proper understanding of these proposals — and, more generally, of attempts to formulate a theory of quantum gravity — requires recognizing the significant and controversial nature of assessing the limits of our current theories.

William F. Brewer *University of Illinois, Urbana-Champaign*

Bruce L. Lambert *University of Illinois, Chicago*

The Theory-Ladenness of Observation and the Theory-Ladenness of the Rest of the Scientific Process

This paper uses evidence from cognitive psychology and the history of science to examine the issue of the theory-ladenness of perceptual observation. The evidence shows that perception is theory-laden, but that is only strongly theory-laden when the perceptual evidence is ambiguous, degraded, or requires a difficult perceptual judgment. The paper argues that debates about the theory-laden issue have focused too narrowly on the issue of perceptual experience and that a full account of the scientific process requires an examination of the theory-laden issue in attention, perception, data interpretation, data production, memory, and scientific communication.

Otavio Bueno *California State University, Fresno*

Application of Mathematics and Underdetermination

Recent work in the philosophy of mathematics has focused on the indispensability argument. According to this argument, we should believe in the existence of mathematical entities, since they are indispensable to our best scientific theories. Empiricists have often tried to resist the commitment to unobservable entities in science by using the underdetermination argument. Given that scientific theories are typically underdetermined by the data, we are not forced to believe in the unobservable entities that such theories posit. In this paper, I extend the underdetermination argument to the application of mathematics, arguing that, similarly to its counterpart in science, the argument provides an empiricist alternative to avoid ontological commitment to mathematical objects. In this way, a strategy is presented to resist the conclusion advanced by the indispensability theorist.

Craig Callender *London School of Economics*

Nick Huggett *University of Illinois, Chicago*

Why Quantize Gravity (or Any Other Field For That Matter)?

The quantum gravity program seeks a theory that handles quantum matter fields and gravity consistently. But is such a theory really required and must it involve quantizing the gravitational field? We give reasons for a positive answer to the first question, but dispute a widespread contention that it is inconsistent for the gravitational field to be classical while matter is quantum. In particular, we show how a popular argument (Eppley and Hannah 1977) falls short of a no-go theorem, and discuss possible counter-examples. Important issues in the foundations of physics are shown to bear crucially on all these considerations.

Xiang Chen *California Lutheran University*

Perceptual Symbols and Taxonomy Comparison

Many recent cognitive studies reveal that human cognition is inherently perceptual, sharing systems with perception at both the conceptual and the neural levels. This paper introduces Barsalou's theory of perceptual symbols and explores its implications for philosophy of science. If perceptual symbols lie in the heart of conceptual processing, the process of attribute selection during concept representation, which is critical for defining similarity and thus for comparing taxonomies, can no longer be determined solely by background

beliefs. The analogous nature of perceptual symbols and the spatial nature of intraconceptual relations impose new constraints to attribute selection. These constraints help people with different background beliefs select compatible attributes, which constitute a common “platform” for taxonomy comparison.

Wayne Christensen *University of Newcastle*
C. A. Hooker *University of Newcastle*

Self-directed anticipative learning processes in science

A major problem facing current philosophy of science is how to integrate accounts of individual cognition and social processes into a cognitive theory of science. However an interactivist-constructivist (I-C) approach to cognition based in organised processes casts light on these problems by highlighting the role of interaction in the construction and modification of scientific research. This paper develops some of the implications of I-C for understanding the scientific process by extending to science an original, naturally situated cognitive learning model, self-directed anticipative learning.

Rob Clifton *University of Pittsburgh*

Nonlocality and Entanglement in Quantum Information Theory

It is a widely held belief that the key to quantum enhancements of classical computation power lies in the availability of entangled states. And one can hardly doubt that entanglement and/or non-locality is an important resource in quantum information processing, as illustrated by quantum teleportation and dense coding. It is not surprising, then, that physicists in recent years have been led to a far deeper understanding of the nature of entanglement. The central foundational problems that remain involve characterizing, in the case of a mixed quantum state (representable only by a density operator) “how entangled” the state is and “how nonlocal” it is. For example, while there is a uniquely natural measure of entanglement for pure states, based on von Neumann entropy, there are a number of apparently distinct yet useful measures for mixed entangled states. Moreover, there are mixed entangled states that are ‘bound entangled’, i.e., no pure entanglement (in the form of singlet states) can be distilled from them. At a more fundamental level, while every pure entangled state dictates nonlocal Bell correlations (violates some Bell inequality), mixed entangled states need not; yet, perhaps strangely, such “Bell insensitive” states can still be used to teleport with a delity better than any possible classical implementation! Bell-correlated states must necessarily be entangled. However, there is no known characterization of the Bell-correlated mixed states amongst those that are entangled, beyond the simplest case of a

pair of spin-1/2 particles. There is not even an effective characterization of the entangled states themselves, amongst the set of all mixed states. Philosophers of quantum theory, expert at making conceptual distinctions and certainly no strangers to the density operator formalism (cf. Gleason's theorem and the 'ignorance interpretation of mixtures'), have almost entirely ignored these foundational problems. The present paper will survey the problems, discuss their connection to problems in quantum information theory, and draw out some of their implications for the voluminous philosophical literature on quantum nonlocality.

Alberto Cordero *Queens College & The Graduate Center*

Realism And Underdetermination: Some Clues from The Practices-Up

Current theorizing about the nature of material systems effectively resolves into a multiplicity of absolutely incompatible statements about physical systems and their representation. Specifically, the most articulate recent attempts to turn Standard Quantum Theory (SQT) into a coherent system, though much better than previous offerings, flounder in effective empirical underdetermination and mutual empirical equivalence, reviving old anti-realist fears about quantum physics. I discuss such fears and find them unsound nothing of global skeptical or agnostic significance really follows from the kind of underdetermination presently encountered in fundamental quantum theory. The case is instructive, however, for what it shows about the characteristics and prospects of scientific realism as a perspective in contemporary philosophy of science.

Kim Cuddington

The "Balance of Nature" metaphor in population ecology: theory or paradigm?

I claim that the balance of nature metaphor operates as a shorthand for a paradigm which view nature as a beneficent force. I trace the cultural origins of this concept and demonstrate that it operates today in the discipline of population ecology. Although it might be suspected that this metaphor operated a pre-theoretic description of the more precisely defined notion of equilibrium, I demonstrate that the balance concept has been used to define those types of equilibrium which are deemed natural. This interaction suggests that the metaphor is much more than a precursor of the theoretical concept of population equilibrium.

Bryon Cunningham *Emory University*

The Reemergence of ‘Emergence’

A variety of recent philosophical discussions, particularly on topics relating to complexity, have begun to reemploy the concept of ‘emergence.’ Although multiple concepts of ‘emergence’ are available, little effort has been made to systematically distinguish them. In this paper, I provide a taxonomy of higher-order properties that (inter alia) distinguishes three classes of emergence: (1) ontologically basic properties of complex entities, such as the mythical vital properties, (2) fully configurational properties, such as mental properties as they are conceived by functionalists, and (3) highly configurational/holistic properties, such as the higher-level patterns characteristic of complex dynamical systems.

Erik Curiel *Stanford University*

Against the Excesses of Quantum Gravity: A Plea for Modesty

I argue that all current research programs in quantum gravity conform to the 17th century hypothetico-deductive model of scientific inquiry, perhaps of necessity given the state of technology. In so far as they do not recognize and advertise the shortcomings of the research method they use, they do a disservice to the integrity of science, for the method admits of far less certainty accruing to its products than one would be led to believe by the pronouncements of researchers in the area.

Robyn M. Dawes *Carnegie Mellon University*

The Ethics of Using or Not Using Statistical Prediction Rules in Psychological Practice and Related Consulting Activities

Scientific theory and understanding cannot be reduced to a set of prediction equations, but ability to predict even what will be found about past events (as in an autopsy or archeological dig) constitutes the criterion for meeting the “show me” demand of all scientific assertions. Moreover, applied work also demands predictive capacity. A practitioner can influence change in a desirable direction only when able to predict what is likely to occur as the result of various possible interventions, or none at all. While some physical processes follow deterministic principles (at certain levels of analysis anyway), and while some analysts accept as a matter of faith that processes in psychology and other social sciences would “ultimately” be deterministic “if only we know enough,” most such processes are for all practical purposes probabilistic. Moreover, medicine is as well at

least until encountering a “pathognomic” sign or symptom (one that occurs only in the presence of a particular pathology). Thus, it is not surprising that a number of investigators in these areas have developed Statistical Prediction Rules (SPR’s); some of these rules are situation specific, some developed to be valid across a variety of situations. Once an SPR has been developed (and validated) to apply to a particular situation, practitioners in that situation faces three possible ways of making a prediction. Method #1: Relying on past experience and training to make an intuitive prediction. Method #2: Relying wholly on the SPR developed to be used in that situation. Method #3: Taking account of the output of the SPR but possibly modifying it on the basis of professional experience and intuition.

In his classic 1954 book, Paul Meehl summarized approximately 20 studies comparing the predictive validity on methods #1 and #2. In no case was Method #1 superior. By 1996, Grove and Meehl were able to summarize about 135 studies comparing methods #1 and #2. In less than five per cent was there evidence for the superiority of method #1. Recently, Swets, Monahan, and Dawes have compared all three methods in the areas of psychology and medicine. In the former area (e.g. predicting future violence, success on parole, success in a professional or academic program), method #2 was clearly the best. In medicine, sometimes Method #2 was superior and sometimes Method #3 was. In no case was Method #1 superior to either of the others. Swets, Monahan and Dawes used the signal detection statistic of the area under Received Operating Curves (ROC’s) as their criterion of predictive validity. Other investigators have used correlation coefficients and accuracy of categorization without any differences in the direction of the results and their implications. The major implication of all this research is that to practice ethically, the practitioner in these areas must employ SPRs (either method #2 or #3) when they are available. Moreover, the practitioner claiming to use his or her own intuition to “improve” an SPR has an ethical obligation to keep track of outcomes to see if modification really does result in improvement (and must be wary of confounded judgments, self-fulfilling prophecies and other challenges to the validity of evaluating such feedback). These ethical mandates following from the research are quite different from those commonly believed to be in operation, where “responsibility” is interpreted as “accepting it” for “making the predictive judgment oneself.” Rather, responsibility implies relinquishing some, or total, control over that judgment.

James K. Derden Jr. *Humboldt State University*

A Different Conception of Scientific Realism:
The Case of the Missing Explanandum

Given the ideal conditions used in constructing empirical mathematical laws, one finds and should expect that the values deduced from such laws (C-values) will not agree with the measured values for the same variable (O-values). These conditions are constitutive of such laws, and the latter are acceptable only if

their O and C-value differences can be explained in terms of the factors idealized. A conception of realism emerges where the laws are true but misrepresent reality, have false C-value predictions, are not accepted because of their truth or approximate truth, and are acceptable only if the differences are explained.

Michael Dickson *Indiana University*

Quantum Logic Is Alive (And It Is True Or It Is False)

Is the quantum-logic interpretation dead? Its near total absence from current discussions about the interpretation of quantum theory suggests so. While mathematical work on quantum logic continues largely unabated, interest in the quantum-logic interpretation (as found in (Hooker, 1979), for example) seems to be almost nil, at least in Anglo-American philosophy of physics. This paper has the immodest purpose of changing that fact. I shall argue that while the quantum-logic interpretation faces challenges, it remains a live option. The usual objections either miss the mark, or admit a reasonable answer, or fail to decide the issue conclusively.

Mauro Dorato *University of Rome III, Italy*

On Becoming, Cosmic Time And Rotating Universes

In the literature on the compatibility between the time of our experience and the time of physics, the special theory of relativity (STR) has curiously enjoyed central stage. In this paper, I claim that it is time to bring into the discussion the general theory of relativity. I begin by suggesting a new analysis of the misunderstood notion of becoming, which I developed from hints in Gödel's published and unpublished material. I then discuss Gödel's argument for the ideality of time, based on his own "rotating" solution to Einstein's field equation. I conclude that the recent endorsements of such an argument by Yourgrau and Savitt fail: once we understand the notion of becoming in the right way, there is no reason to consider it as being incompatible with physical time. My way of looking at becoming should also dissolve the century-old debate between the tensed and the tenseless theory of time.

Phil Dowe *University of Tasmania*

Causal Loops and the Independence of Causal Facts

Swinburne (The Concept of God) and Mellor (ch 12, Real Time II) reject the possibility of causal loops on the grounds that they are incompatible with the

logical independence of causal facts. Mellor in particular argues that argues on the basis of the logical independence of causal facts together with ‘laws of large numbers’, that causal loops are impossible because they produce inconsistent sets of frequencies. In this paper I offer an improved version of his argument, clarifying the relevant independence assumption, but argue nevertheless that it would be preferable to abandon the improved independence assumption in the case of causal loops. I offer three arguments for this view.

Armond Duwell *University of Pittsburgh*

Explaining Information Transfer in Quantum Teleportation

Quantum teleportation is a recently discovered phenomenon whereby quantum information can be transferred from some location A to another location B without physically moving quantum information from A to B. Several explanations of information transfer in quantum teleportation have surfaced. I examine four of them. After reviewing some elementary results about teleportation I argue that only one of the four could be acceptable. I also argue that there are several different concepts of information employed in these explanations and as such they have differing explanandums.

Adam Elga *Massachusetts Institute of Technology*

Statistical mechanics and the asymmetry of counterfactual dependence

In “Counterfactual dependence and time’s arrow”, D. Lewis defends an analysis of counterfactuals intended to yield the asymmetry of counterfactual dependence: that later affairs depend counterfactually on earlier ones, and not the other way around. I argue that careful attention to the dynamical properties of thermodynamically irreversible processes shows that in many ordinary cases, Lewis’s analysis fails to yield this asymmetry. Furthermore, the analysis fails in an instructive way: one that teaches us something about the connection between the asymmetry of overdetermination and the asymmetry of entropy.

Christopher Eliot *University of Minnesota*

A Field Guide to Reduction in Ecology

Philosophical accounts of reductionism have not clearly illustrated cases of reduction in biology, and, if at all, certainly not in ecology. Philosophers and biologists have moreover offered a number of arguments aimed at demonstrating that ecology is not reductive. Both reductionists with respect

to some science, then, and anti-reductionists with respect to ecology have treated ecology as not being reductive. This position is contradicted, however, by some ecologists view of their own work as reductive. Recognizing this tension, I illustrate three kinds of reductive research strategies which ecologists have made use of in developing models.

Kevin Elliott *University of Notre Dame*

Chemical Hormesis: Assessing the Warrant for Policy-Driven Science

This paper examines the epistemological warrant for a toxicological phenomenon known as chemical hormesis, which may have significant implications for public policy. Section II argues that conceptual confusion about the nature of chemical hormesis contributes significantly to current disagreements about the status of chemical hormesis as a biological hypothesis. Section III provides an analysis of seven distinct (though not mutually exclusive) concepts of chemical hormesis and argues that none of them are completely satisfactory. Section IV argues that the conceptual clarification performed in section III suggests at least three ramifications for ongoing debates about the epistemological status of chemical hormesis.

Marc Ereshefsky *Department of Philosophy*

Linnaean Ranks: Vestiges of a Bygone Era

We tend to think that there are different types of biological taxa: some taxa are species, others are genera, while others are families. Linnaeus gave us his ranks in 1731. Needless to say, biological theory has changed since Linnaeus's time. Creationism and essentialism have given way to evolutionary theory and classifications based on genealogical relations. Nevertheless, the vast majority of biologists still assign Linnaean ranks to taxa even though that practice is at odds contemporary theory. Furthermore, the assignment of Linnaean ranks causes a number of practical problems, including needless arguments over the ranks of taxa as well as avoidable semantic confusions. The Linnaean ranks should be abandoned and alternative methods for displaying the hierarchical relations of taxa should be adopted.

Don Fallis *University of Arizona*

Measures of Epistemic Utility and the Value of Experiments

Measures of epistemic utility have been used to model the epistemic decisions of truth seekers in general and scientists in particular. (See, for example, Levi's

Gambling With Truth.) Such measures are invariably discrete in the sense that they assign different epistemic values to only a finite number of epistemic states. In this paper, I defend a measure of epistemic utility that assigns different epistemic values to a continuum of epistemic states. Interestingly, on this continuous measure of epistemic utility, there are plausible counter-examples to Carnap's "principle of total evidence" (in particular, to the claim that performing experiments is always epistemically valuable).

David Faust *University of Rhode Island*

Using Meta-Scientific Studies to Clarify or Resolve Questions in the
Philosophy and History of Science

The resolution or clarification of certain key, longstanding issues in the philosophy and history of science, particularly normative ones, may be greatly facilitated by augmenting and supplementing methods of analysis and study. Faust and Meehl have described such methodology and its underlying assumptions and rationale under the label of "meta-science." In this presentation, I will discuss the basic underlying tenants of the "Faust-Meehl Thesis," describe new indices for evaluating the status of scientific assertions and theories and the combination of such indices, and provide examples of their use in narrow and broad contexts. Examples include the application of meta-scientific methods to the evaluation of grant proposals and theories. Meta-scientific study of the type described here may aid, in particular, in determining the links between prescriptive advice and the success of scientific endeavors, and between the standing of theories on various dimensions (e.g., predictive and explanatory power) and their long-term fate.

Carla Fehr *Iowa State University*

The evolution of sexual reproduction:
pluralism that is more than a pragmatic issue

The evolution of sexual reproduction is a case of explanatory pluralism, meaning that there is more than one explanation for this phenomenon. I use the concept of a domain to more clearly explicate the various explananda that can be found in this case. I argue that although pluralism with respect to some types of domains can be decreased using van Fraassen's pragmatics of explanation, there remains an important class of domain, an orthogonal domain, for which this is not the case.

Branden Fitelson *University of Wisconsin-Madison*

A Bayesian Account of Independent Evidence with Applications

A Bayesian account of independent evidential support is outlined. This account is partly inspired by the work of C.S. Peirce. I show that a large class of (but surprisingly not all) quantitative Bayesian measures of confirmation satisfy the basic desiderata laid down by Peirce for adequate accounts of independent evidence. I argue that by considering further natural constraints on a probabilistic account of independent evidence, all but a very small class of Bayesian measures of confirmation can be ruled-out as failing to adequately cope with cases of independent evidence. In closing, another application of our account to the problem of evidential diversity is also discussed.

Owen Flanagan *Duke University*

Is the Neural Level Privileged in the Explanation of the Mental?

A critical discussion of pragmatic and non-pragmatic arguments, given by Putnam, Dennett, and Churchland, for privileging the neural level in explanations of the mental. Assuming that the neural level provides the most precise explanation of what is going on in the mind, what implications does this have for our ontological commitments to explanations of mental phenomena in terms of mental causes such as beliefs and desires?

Lisa Gannett *University of California, Davis*

Human Genome Diversity Research: The Ethical Limits of “Population Thinking”

This paper questions the prevailing historical understanding that scientific racism “retreated” in the 1950s when anthropology adopted the concepts and methods of population genetics and race was recognised to be a social construct and replaced by the concept of population. More accurately, a “populational” concept of race was substituted for a “typological one” - this is demonstrated by looking at the work of Theodosius Dobzhansky circa 1950. The potential for contemporary research in human population genetics to contribute to racism needs to be considered with respect to the ability of the typological-population distinction to arbitrate boundaries between racist society and nonracist, even anti-racist, science. I point out some ethical limits of “population thinking” in doing so.

Ronald N. Giere *University of Minnesota*

The Perspectival Nature of Scientific Observation

Scientific observation, I claim, is perspectival. My paradigm for perspectivism is human color vision. Rejecting both claims that colors are objective and claims that they are subjective, I argue that colors are perspectival. They are part of the perspective from which humans view the world. Using examples from astronomy, I then point out that scientific observation is perspectival in roughly the same way as human color vision. Although perspectivism is often dismissed as just another form of relativism, I argue that it is a form of realism, and that this is a perfectly reasonable conclusion from fairly obvious scientific facts.

James Guszczka *Allstate Research and Planning*

On the Information Theoretic Approach to Statistical Mechanics

The dual issues of the role of ergodic theory in statistical mechanics and the status of Gibbs' canonical ensemble have long been controversial issues in the philosophy of physics. It is well known that E. T. Jaynes outlined a theory of classical, equilibrium statistical mechanics in which ergodic theory plays no role. Jaynes "derives" the canonical ensemble using a principle of inductive inference known as the Principle of Maximum Entropy [PME]. PME is controversial in its own right, but Jaynes' theory of statistical mechanics faces an even bigger problem: in order to apply PME to the case of statistical mechanics, Jaynes must assume a uniform "prior probability" measure on phase space. This paper does not dwell on the controversies surrounding the PME. However, a concrete justification of the uniform "prior" measure is suggested. Namely, it is pointed out that the uniform measure is implicitly defined by the symplectic structure of the phase space of a classical system. Besides filling the most serious conceptual gap in Jaynes' theory, this result clarifies a point at which Jaynes' theory makes contact with the underlying physics.

Daniel M. Hausman *University of Wisconsin*

Causal Relations Among Tokens, Types, and Variables

There are causal relations between token events, between properties or event types, between variables, and between values of variables. This essay explores what these varieties of causal relation have to do with one another. It presents and criticizes Ellery Eells' view that type-level and token-level causation are independent, and it endorses parts of Daniel Hausman's view that type-level causal claims are modal generalizations of token-level claims. It defends the

thesis, suggested by Kevin Hoover, that causal relations among “concrete” variables are fundamental.

Brian Haynes *McMaster University*

What kind of evidence is it that evidence based medicine advocates want patients, practitioners, policy makers and the public to pay attention to?

Advocates of evidence based medicine (EBM) want health care providers and consumers to pay attention to the best findings from health care research that are both valid and ready for clinical application concerning the cause, course, diagnosis, prevention and treatment of disease. EBM claims that practitioners can know what are valid and best practices through understanding recently developed applied research methods (from the second half of the 20th century) and using this understanding to judge studies published in the medical literature. In doing so, EBM advocates have proclaimed a new paradigm, that was initially and provocatively pitted against traditional medicine, in which the key elements of knowing for clinical purposes are understanding of basic pathophysiologic mechanisms of disease coupled with clinical experience. This initial conception, that EBM is attempting to replace traditional medicine, should to be put to rest: EBM is attempting to augment rather than replace individual clinical experience (which EBM sees as necessary but insufficient to provide best care) with newly derived facts from science that are demonstrably by the new methods of health care research valid and ready for clinical application. These methods reduce bias and eliminate many possible alternative explanations for studies intended to provide clear answers about the nature, detection, and management of health care problems. EBM raises a number of issues that have come to the attention of philosophers of science, including what constitutes best evidence, whether EBM has gone soft in trying to accommodate research designs other than its gold standard of the randomized controlled trial, and whether its approach to methodology is explicable by disunity of science advocates, or in need of a major revision to unify its approach. Also of interest are questions of whether what one learns from groups of patients in relatively contrived research settings can be applied to individuals in usual clinical circumstances. Moral philosophers have taken less interest, but it may be that the ethical issues raised by EBM are even more important, especially dilemmas in distributive justice and prolonging life into the realm of misery and beyond the point of senescence.

Robin Findlay Hendry *University of Durham*

Are Realism and Instrumentalism Methodologically Indifferent?

Arthur Fine and Andre Kukla have argued that realism and instrumentalism are indifferent with respect to scientific practice. I argue that this claim is ambiguous. One interpretation is that for any practice, the fact that that practice yields predictively successful theories is evidentially indifferent between scientific realism and instrumentalism. On the second construal, the claim is that for any practice, adoption of that practice by a scientist is indifferent between their being a realist or instrumentalist. I argue that there are no good arguments for the indifference claim under the second interpretation, and good reasons to think that it is false.

Robert G. Hudson *Algoma University College*

Evaluating Background Independence

Over the years, a number of philosophers have been advocating the following epistemic principle on observations (which I call ‘background independence’): when using observational data to test some theory, use data that do not, in themselves, presuppose the truth of the theory under test. Using as the focus of my criticism Sober’s recent presentation of this principle (Sober 1999), I argue that it has been vaguely interpreted by philosophers and that it has at least two meanings, one which is irrelevant to issues of observational objectivity and the other which is more properly understood as an instance of the Duhem-Quine problem. My conclusion is that background independence is not as important a principle as many people have assumed. Near the end of my paper I draw further support for my view on background independence, support deriving (surprising!) from the work of T. S. Kuhn. I also respond to a possible objection to my view, an objection that highlights the occasional need for blind tests.

R. I. G. Hughes *University of South Carolina*

Conceptual Change and the DDI Account of Theoretical Representation

Ronald Giere has presented an account of theoretical practice couched in terms of models. A variant of this account is coupled with an analysis of the kind of representation that models provide, and the result — the Representational View of Theories — is applied to aspects of the development of 17th and 18th century mechanics. A new perspective is thereby gained, not only on individual moments of this development, but also on transitions that took place within it,

like the move from geometric to algebraic representation, and the hesitant acceptance of Newton's metaphysical concept of force.

Kristen Intemann *University of Washington*

Science and Values: Are Value Judgements Always Irrelevant to the
Justification of Scientific Claims?

Several feminist theorists have claimed that feminist values ought to influence theory choice. Susan Haack has argued that this is implausible because normative claims about what ought to be the case can never provide justification for descriptive claims. I argue against one of the premises of Haack's argument. Furthermore, I attempt to show that the most promising defense of this premise would cast doubt on a second premise of Haack's argument. My aim is to open up the possibility that value judgments can play a legitimate role in theory choice.

Tetsuji Iseda *Nagoya University*

Bridging a Gap Between Naturalistic and Traditional Approaches in the
Philosophy of Science

There seems to be a lack of mutual understanding between naturalistically oriented philosophers and more traditional philosophers in the philosophy of science. This paper attempts to bridge the gap between these two orientations by introducing a conceptual framework: a distinction between action-guiding rules and evaluative principles. To make the argument concrete, I examine exchanges between Frederick Suppe and Bayesians over Suppe's interpretation of W.J. Morgan's plate tectonics paper. Through a re-analysis of the Morgan paper, I conclude that Suppe's account through the special reasons requirement can be made compatible with a Bayesian account, though not quite in the way Bayesians themselves argue.

Jonathan Michael Kaplan *University of Tennessee*

Historical Evidence and Human Adaptations

Phylogenetic information is often necessary to distinguish between competing evolutionary scenarios. Recently, evolutionary psychology has acknowledged this, and has claimed that such evidence can be and has been brought to bear on adaptive hypotheses involving complex human traits. If this were possible, it would be a valuable source of possible tests for hypothesized adaptive traits in humans, especially given that such hypotheses generally cannot be tested by the

sorts of phenotypic manipulations used to test adaptive hypotheses in other species. However, I argue that in practice evolutionary psychology has failed to use phylogenetic information in a meaningful way, and further the structure of the Hominidae family makes such a research program nearly impossible. While phylogenetic information can be useful for testing adaptive hypotheses in humans, these generally involve traits that are (a) not widely shared in the species and (b) of a much lower order of complexity than the sorts of traits evolutionary psychology has been interested in. With respect to complex psychological traits, the human species lacks sufficient genetic variation, and the closest extant relatives to the human species are too phenotypically different from humans, for such methods to provide meaningful tests.

Ruth E. Kastner *University of Maryland*

A critical look at time-symmetric quantum counterfactuals

I identify a loophole in the case against the counterfactual usage of the Aharonov-Bergmann-Lebowitz rule of time-symmetrised quantum theory. I then close the loophole by showing that in order to exploit it, one must violate basic principles of cotenability in standard theories of counterfactuals. The conclusion is that there is no way to formulate a valid counterfactual application of the ABL rule.

Stephen H. Kellert *Hamline University*

Extrascientific uses of physics: the case of nonlinear dynamics and chaos theory

This essay explores the metaphorical use of the area of nonlinear dynamics popularly known as chaos theory, surveying its use in one particular field: legal theory. After sketching some of the mistakes encountered in these efforts, I outline the possibility of the fruitful use of nonlinear dynamics for thinking about our legal system. I then offer some general lessons to be drawn from these examples, both cautionary maxims and a limited defense of cross-disciplinary borrowing. I conclude with some reflections on the nature of arguments that seek to establish intellectual authority or epistemic merit by analogical reasoning.

Kevin T. Kelly *Carnegie Mellon University*

Revolution, Revision, Regress, and Reliability

Scientific method may be viewed either as an argument justifying a conclusion or as a procedure for finding the right answer to some question. Both conceptions occasion the problem of empirical regresses. According to the

former approach, it is hard to say what the point of a regress is. According to the latter, we can solve for the strongest sense of single-method performance that could be covered from a regress of procedures. Several types of regresses are solved in this sense. Some of the solutions are shown to have sufficient power to deal with Duhem's problem.

I. A. Kieseppa *University of Helsinki*

Statistical Model Selection Criteria and Bayesianism

Two Bayesian approaches to choosing between statistical models are contrasted. One of these is an approach which Bayesian statisticians regularly use for motivating the use of AIC, BIC, and other similar model selection criteria, and the other one is a new approach which has recently been proposed by Bandyopadhyay, Boik, and Basu. The latter approach is criticized, and the basic ideas of the former approach are presented in a way that makes them accessible to a philosophical audience. It is also pointed out that the former approach establishes a new, philosophically interesting connection between the notions of simplicity and informativeness.

Frederick M. Kronz *The University of Texas at Austin*

Interpretive Issues of Algebraic Quantum Theory

Algebraic quantum theory is a mathematical framework for modeling quantum fields and large systems of quantum particles. It is quite distinct from and conceptually more powerful than quantum mechanics. Physicists moved beyond quantum mechanics in a serious way in the 1960s. Philosophers of physics have only just begun to do so. Algebraic quantum theory is mature enough, and the philosophy of physics community would benefit greatly by obtaining an understanding of the underlying conceptual framework. Two mathematical structures of algebraic quantum theory, inequivalent representations and type-III factors, are designated here as being essential to any suitable basis for addressing interpretive issues associated with this theory.

Michael B. Kruse *Virginia Polytechnic Institute and State University*

Are There Bayesian Success Stories?: The Case of the Ravens Paradox

One of the main reasons for the popularity of subjective Bayesian confirmation theory is its claim to resolve various problems of confirmation, most notably Hempel's Ravens Paradox. In this paper I discuss a different way to distinguish

sets of data by appealing to the specific processes used to generate those data sets. I then consider a variation on the Ravens Paradox that seems to resist any principled Bayesian resolution, and draw out some implications of this result for the prospects of Bayesianism as a general philosophy of science.

Henry E. Kyburg Jr. *University of Rochester and The Institute for Human and Machine Intelligence*

The Dutch Book Argument and Rational Belief

The Dutch Book Argument is the argument that if one's degrees of belief fail to satisfy the probability axioms, then a clever bookie can propose a set of bets that one will find acceptable, but which entail a sure loss. It has been used to support the claim that rational degrees of belief must be probabilities. It is argued here that the acceptability of a set of bets may be quite different from the acceptability of a single bet, that if this difficulty is corrected by demanding that the agent be willing to accept any combination of bets that he is willing to accept singly, then the sanctions supporting that demand undermine the cogency of the argument, that the requirement that "degrees" of belief be measured by real numbers between 0 and 1 is epistemologically unreasonable, and that even if the Dutch Book Argument is applied to intervals of belief, and the necessary sanctions taken account of, the conclusion will concern posted odds only (rather than belief), and will require that these not be probabilities. What we can conclude (with additional premises) is that rational belief should conform to probability (in a sense to be specified), and that decisions should be governed by expectations. This is a far weaker conclusion than that the Dutch Book Argument is ordinarily taken to support.

Marc Lange *University of Washington*

The Apparent Superiority of Prediction To Accommodation as a Side Effect: A Reply to Maher

Maher (1988, 1990, 1993) has offered a lovely example to motivate the intuition that a successful prediction has a kind of confirmatory significance that an accommodation lacks. This paper scrutinizes Maher's example. It argues that once the example is tweaked, the intuitive difference between prediction and accommodation disappears. This suggests that the apparent superiority of prediction to accommodation is actually a side effect of an important difference between our judgements of the hypotheses that tend to arise in each case.

Christopher Lehner *California Institute of Technology*

Which Way Does It Cut? Ockham's Razor in No-Collapse Interpretations

Everett's interpreters have often come to the conclusion that it is impossible to give a rational assessment of the merits of his model for quantum mechanics. This paper proposes to understand Everett's theory through an eliminative procedure: Starting from Bohm's model, which is on most accounts well understood, Bohm's assumptions about the existence of objective particle trajectories are eliminated in three steps. It is claimed that the resulting model is the kind of "pure wave mechanics" that Everett envisioned. The three steps amount to claims that features of Bohm's model are not necessary to explain the appearance of well-defined measurement outcomes. Assessing the validity of arguments for and against these claims can give a rational basis for a discussion of the defensibility of Everett's model.

Isaac Levi *Columbia University*

Dynamic Dutch Book Arguments are Incoherent!

It is widely argued that rational agents ought always to satisfy the requirement that strict preferences be transitive. This view is often defended by threatening those whose strict preferences are not transitive with becoming "money pumps". Suppose Jones prefers A to B, B to C and C to A. Jones should be prepared to pay a certain amount of money to exchange C for B. Once in possession of B, Jones should pay something to exchange B for A. But then he should be prepared; to pay a positive amount to exchange A for C. Jones has what he had initially minus a certain amount of money. To avoid this, so the argument runs, Jones should retain transitive preferences. This is a well-known illustration of a kind of argument where a decision maker faces a sequence of decisions that leave him worse off than he was before. There are other such arguments such as the Teller-Lewis argument for conditionalization that argues for the so called principle of conditionalization by suggesting failure to conform will be rewarded with becoming a money pump or having a dynamic Dutch Book made against the one who violates conditionalization. Such arguments rest on assumptions insisting that rational agents should not only satisfying certain constraints on their consistency or coherence at a given time but also constraints on their coherence over time. I shall argue that no principles of dynamic consistency or coherence ought to be imposed on rational agents. This is so even though I think there are principles of synchronic rationality to be imposed on decision-makers. My arguments rest on assumptions about the scope and purpose of principles or synchronic rationality and their relation to practical deliberation. The three items mentioned below indicate some main philosophical premises of these arguments. Principles of synchronic rationality impose constraints on the agent's commitments as to what to believe, value,

recognize as optional, suppose and choose. There is always a gap between the agent's commitments and fulfillment of these commitments. As a consequence there is a difference between changes in the various attitudes cited above that are changes in commitments and changes in performance fulfilling such commitments. Advocates of principles of diachronic rationality sometimes seem to conflate these two kinds of changes. Deliberation crowds out prediction: An agent deliberating as to which of the options the agent recognizes to be available ought to be chosen and implemented cannot coherently in the same context assign unconditional probabilities to the propositions predicting the agent's implementation of these options. Prediction crowds out deliberation. If an agent predicts that the agent will implement a given project, implementation cannot be under the agent's control from the agent's point of view. I shall elaborate on these ideas and explore some of their ramifications for decision making and belief change using illustrations derived from the literature on injunctions against Dutch Books or choosing options that are "dominated" by others.

Peter J. Lewis *University of Miami*

In Which Error Statistics Rescues Realism from the Pessimistic Induction

The pessimistic induction is a family of arguments, each to the effect that the falsity of past scientific theories undermines our justification for thinking that current scientific theories are true. Putnam and Laudan present rather different versions of the pessimistic induction, but both fall within the naturalistic tradition in philosophy, which holds that philosophical claims such as realism are to be evaluated on the basis of empirical evidence. Most of the considerable literature on this topic attempts to defend scientific realism by attacking the historical evidence. However, I argue that a careful look at scientific methodology, using error statistics (Mayo 1996), shows that both Putnam and Laudan make methodological mistakes that render their evidence harmless to scientific realism. Even if all their historical claims are granted, their conclusions acquire no empirical support.

Michelle Little *Northwestern University*

Rethinking Experimentation

Hacking (1983) argues against a linguistic, representational approach to justifying our beliefs that the unobservable entities described in the sciences really exist. He favors in its stead an experimenting approach such that "engineering, not theorizing, is the best proof of scientific realism about entities" (1983: 274). In light of that perspective, *Representing and Intervening* concludes with a skepticism about the existence of black holes (p. 275), a position he expanded six years later in "Extragalactic Reality: The Case of Gravitational Lensing."

Hacking's astrophysical skepticism, particularly as expressed in his writing on gravitational lenses, has generated a smattering of responses that center primarily on his defense of realism (Morrison 1990, Shapere 1993, Reiner and Pierson 1995). But although Hacking tightly connects the topics of experimentation and realism, this paper will not properly address the latter. I instead investigate Hacking's views on experimentation. Experimentation for Hacking serves as a demarcation criterion between the natural and non-natural sciences, and as a justificatory means for substantiating claims that the unobservable entities studied by a natural science really exist. I challenge his notion of experiment's success in either role, and offer in its place a different conception of experimentation. My view emphasizes different features than Hacking does, but does not destroy his basic - and sensible - idea: that interacting with an entity (or at least its causal powers) plays an important part in the comfort level scientists have with the idea that the entities they discuss but cannot put their hands on exist.

Chuang Liu *University of Florida*

Infinite Systems in SM Explanations: Thermodynamic Limit,
Renormalization (semi-) Group, and Irreversibility

This paper examines the justifications for using infinite systems to 'recover' thermodynamic properties, such as phase transitions (PT), critical phenomena (CP), and irreversibility, from the micro-structure of matter in bulk. Section 2 is a summary of such rigorous methods as in taking the thermodynamic limit (TL) to recover PT and in using renormalization (semi) group approach (RG) to explain the universality of critical exponents. Section 3 examines various possible justifications for taking TL on physically finite systems. Section 4 discusses the legitimacy of applying TL to the problem of irreversibility and assesses the repercussion for its legitimacy on its home turf.

Holger Lyre *Ruhr-University Bochum*

Gauge Theoretic Conventionalism and the Generalized Equivalence Principle

The underlying principle of gauge field theories is the so-called gauge principle, which is based on the idea of deriving the coupling structure of matter-fields and gauge-potentials by satisfying a postulate of local gauge covariance. It is common knowledge to consider this principle as sufficient to dictate the full structure of gauge theories. This paper contains a critique of this usual point of view: first, by emphasizing an intrinsic gauge theoretic conventionalism and, second, by introducing a generalized equivalence principle - the identity of inertial and field charge (as generalizations of inertial and gravitational mass) - to justify the combination of equations of motion and field equations.

David MacCallum *Carleton College*

Quantum Entanglement and Classical Computations

There are computational tasks that can be shown to be 'easy' for a quantum computer, even though they appear to be 'hard' for all classical computers. This increased computational power is based on a form of parallelism in quantum computation that requires entangled states. This use of entangled states appears to conflict with the classical models of computation developed by mathematicians and logicians. I will argue that, in an important sense, the physical processes we call quantum computations are not classical computations. However, I do think that we are justified in calling them computations. Thus, quantum computation gives us a good reason to generalize our mathematical models of computation.

Eric Martin *University of New South Wales*

Daniel Osherson *Rice University*

Scientific Discovery from the Perspective of Hypothesis Acceptance

A model of inductive inquiry is defined within the context of first-order logic. The model conceives of inquiry as a game between Nature and a scientist. To begin the game, a nonlogical vocabulary is agreed upon by the two players, along with a partition of a class of countable structures for that vocabulary. Next, Nature secretly chooses one structure (the real world) from some cell of the partition. She then presents the scientist with a sequence of facts about the chosen structure. With each new datum the scientist announces a guess about the cell to which the chosen structure belongs. To succeed in his inquiry, the scientist's successive conjectures must be correct all but finitely often, that is, the conjectures must converge in the limit to the correct cell. Different kinds of scientists can be investigated within this framework. At opposite ends of the spectrum are dumb scientists that rely on the strategy of induction by enumeration, and smart scientists that rely on an operator of belief revision. We report some results about the scope and limits of these two inductive strategies.

James Mattingly *Indiana University*

Singularities and Scalar Fields. Matter Theory and General Relativity

Philosophers of physics should be more attentive to the role energy conditions play in GR. I review the changing status of energy conditions for quantum fields presently there are no singularity theorems for semiclassical GR. So we must reevaluate how we understand the relationship between GR, QFT and singularities. Moreover, on our present understanding of what it is to be a

reasonable field, the standard energy conditions are violated classically. Thus the singularity theorems are unavailable for classical GR. Our understanding of singularities in GR turns on delicate issues of what it is to be a matter field issues distinct from the content of the theory.

Patrick J. McDonald *University of Notre Dame*

Demonstration by Simulation: The Centrality of Experiment for
Helmholtz's Theory of Perception

Hermann von Helmholtz developed a comprehensive theory of perception. The paper argues that experiment is central to his theory, fulfilling three functions. One, arguments for the theory arise out of empirical research. Two, the idea of experiment spans a critical gap in the account of perception. Since the senses fail to reach the nature of actuality, experimentation and the discovery of law-like relationships are necessary to achieve empirical knowledge. Three, experimental practice elaborates the theory, revealing an arena indispensable to its understanding. To clarify, the essay focuses on Helmholtz's analysis and synthesis of human vowels and explanation of tonal timbre.

Roberta L. Millstein *California State University, Hayward*

Is the Evolutionary Process Deterministic or Indeterministic? An Argument
for Agnosticism

Recently, philosophers of biology have debated the status of the evolutionary process: is it deterministic or indeterministic? I argue that there is insufficient reason to favor one side of the debate over the other, and that a more philosophically defensible position argues neither for the determinacy nor for the indeterminacy of the evolutionary process. In other words, I maintain that the appropriate stand to take towards the question of the determinism of the evolutionary process is agnosticism. I then suggest that an examination of the phenomenon of developmental noise might yield a solution to the problem.

Samuel Mitchell *Mount Holyoke College*

Confirming Theories One Claim at a Time

The paper gives an example of a means of confirming scientific theories from a sequence of hypotheses, so that at any point every auxiliary used has already been confirmed. The data observed and the theoretical context determine which hypothesis is confirmed or refuted by each experiment. I argue that the process is not foundationalist. The objective is to demonstrate that under some real

circumstances solely the known data can fix praise or blame within a theoretical context. This result is contrary to what has long been accepted.

Bradley Monton *University of Kentucky*

On Dualistic Interpretations of Quantum Mechanics

Dualistic interpretations attempt to solve the measurement problem of quantum mechanics by postulating the existence of non-physical minds, and by giving a suitable dynamical equation for how these minds evolve. I consider the relative merits of three extant dualistic interpretations (Albert and Loewer's single-mind and many-minds interpretations, and Squires interpretation), and I defend Squires interpretation as preferable to the Albert/Loewer interpretations. I also argue that, for all three of these interpretations, the minds evolve independently of the physical universe, and hence render the physical universe otiose; the interpretations are better viewed as supporting not dualism, but mental monism.

Thomas Mormann *University of the Basque Country (EHU/UPV)*

A Quasianalytical Constitution of Physical Space

One of the most incisive criticisms of Carnap's Aufbau is Quine's who contended that the Aufbau account of the constitution of the physical world is fatally flawed. According to him, statements of the form "Quality q is at point-instant $x;y;z;t$ " cannot be reconstructed in terms of Carnap's initial language of sense data and logic. According to Quine, the connective "is at" remains an added undefined connective. In this paper it is proved that this contention is wrong. The proof makes use of the conceptual machinery of incidence geometry.

Wayne C. Myrvold *University of Western Ontario*

Einstein's Untimely Burial

There seems to be a growing consensus that any interpretation of quantum mechanics other than an instrumentalist interpretation will have to abandon the requirement of Lorentz invariance, at least at the fundamental level, preserving at best Lorentz invariance of phenomena. In particular, it is often said that the collapse postulate is incompatible with the demands of relativity. It is the purpose of this paper to argue that such a conclusion is premature, and that a covariant account of collapse can be given according to which the state

histories yielded by different reference frames are the Lorentz transforms of each other, and furthermore can be regarded as nothing more than different descriptions of the same processes and events.

Jay Odenbaugh *University of Calgary*

Ecological Stability, Model Building, and Environmental Policy: A Reply to Some of the Pessimism

Recently, there has been a rise in pessimism concerning what theoretical ecology can offer conservation biologists in the formation of reasonable environmental policies. In this paper, I look at one of the pessimistic arguments offered by Kristin Shrader-Frechette and E. D. McCoy (1993, 1994)—the argument from conceptual imprecision. I suggest that their argument rests on an inadequate account of the concepts of ecological stability and that there has been conceptual progress with respect to complexity-stability hypotheses. Such progress, I maintain, can supply important resources for conservation biologists in determining environmental policies.

Oswaldo Pessoa Jr. *CLE, Unicamp*

Counterfactual Histories: The Beginning of Quantum Physics

This paper presents a method for investigating counterfactual histories of science. A central notion to our theory of science are “advances” (ideas, data, etc.), which are units passed among scientists and which would be conserved in passing from one possible history to another. Advances are connected to each other by nets of causal influence, and we distinguish strong and weak influences. Around sixty types of advances are grouped into ten classes. As our case study, we examine the beginning of the Old Quantum Theory, using a computer to store and process historical information. We describe four plausible possible histories, besides six other implausible ones.

Jean-Pierre Marquis *Universite de Montreal*

Category Theory: From Fundamentals to the Foundations

Our main goal in this paper is to clarify the status, from a philosophical standpoint, of category theory in the foundations of mathematics. We will proceed in three steps. First, we will briefly examine various philosophical motivations underlying foundational research and extract basic but disputable presuppositions underlying these researches. Second, we will propose

alternative presuppositions and connect them to the specific case of the foundations of geometry. This will show that we can distinguish mathematically fundamental features of a geometry from the traditional foundations of that geometry. We will then argue that the same can be done for category theory, since the latter exhibits the fundamentals of mathematics and that from there, a philosophically appealing program, currently being developed by many logicians and mathematicians, can be envisaged.

Glenn Parsons *University of Alberta*
Patrick McGivern *University of Alberta*

Can the Bundle Theory save Substantivalism from the Hole Argument?

One of the most serious theoretical obstacles to contemporary space-time substantivalism is the dilemma produced by the hole argument. We argue that adopting the bundle of universals theory of substance allows space-time substantivalists to escape from this dilemma. Several philosophers, however, have claimed that the bundle of universals theory and substantivalism are actually incompatible. We argue that these claims are unfounded. However, we find that although the positions are not logically incompatible, combining substantivalism with the bundle of universals theory can lead to a commitment to various problematic theses about the nature of space-time.

Massimo Pigliucci *University of Tennessee*

Genotype-environment interactions and our understanding of the biological bases of human cognitive abilities

The debate on the biological bases of human characteristics, and especially of cognitive abilities, has been raging in philosophy and biology essentially forever. The two extreme positions maintain that either a) the genes of an individual causally explain most of her characteristics, with the environment playing a modifier role, or b) the environments (physical but especially cultural) to which an individual is exposed during her life are the major determinants of her behavior, with the genes playing a secondary role. There is indeed convincing evidence to support both positions, but that does not mean that the truth lies somewhere in the middle. Where would this middle be? Surely nobody think it possible to Solomonicly divide an individual's intelligence or creativity in percentages due to the environment experienced by or to the genetic makeup of that individual. I will submit that the conceptual solution to the conundrum has already been provided by the study of genotype-environment interactions as understood in the context of the modern theory of reaction norms and phenotypic plasticity. However, no relevant data of this

type can be obtained for humans because of ethical considerations as well as technical difficulties. While interesting conclusions can be derived for other mammals, and possibly even for some primates, the study of nature vs. nurture in humans is indeed very limited, and it is about time that the scientific community refrains itself from making grand statements that cannot be reasonably substantiated by the available evidence. This especially in light of the obvious implications of such studies for social and educational policies.

Cassandra L. Pinnick *Western Kentucky University*

Error and Underdetermination: The Status of Metamethodology

In her book, *Error and the Growth of Experimental Knowledge*, Deborah Mayo maintains that her new use of error statistics can resolve the abiding Duhem Problem that some philosophers and sociologists of science believe to plague scientific evidence and knowledge. My paper considers, first, Mayo's response to certain of Larry Laudan's cautions to the scientific methodologist regarding experimental design and normativity. Next, I take up the question of how well Mayo's methods fare in rendering the Duhem Problem toothless. I examine possible criticisms that center on Mayo's method of severe test; these criticisms focus on the methodological—rather than the logical—gaps possibly remaining as between evidence and theory and how any such gaps might risk loss of normative power for Mayo's overall methodology.

Itamar Pitowsky *The Hebrew University*

Quantum Speedup of Computations

Physicists often interpret the Church-Turing Thesis as saying something about the scope and limitations of physical computing machines. Although this was not the intention of Church or Turing, the Physical Church-Turing Thesis is interesting in its own right. Consider, for example, Wolfram's formulation: "One can expect in fact that universal computers are as powerful in their computational capabilities as any physically realizable system can be... No physically implementable procedure could then shortcut a computationally irreducible process." Wolfram's claim is not just that any physically computable function (from natural numbers to natural numbers) is recursive. He maintains, furthermore, that any theoretical bound on Turing machine (TM) computation reflects a physical limitation. For example, suppose that we can prove that the fastest TM computation of a given function runs in exponential number of steps (in the size of the input). This, says Wolfram, constrains the actual time of computation of that function on any real physical machine. An even more extreme formulation can be found in Aharonov's excellent review of quantum

computation. She calls it The Modern Church's Thesis: "A probabilistic Turing machine can simulate any reasonable physical device in polynomial cost." As they stand, these claims are rather vague (mainly because it is not readily clear how to translate TM memory, and TM number of computation steps, into physical space-time variables.) However, the connection can be made more precise in a number of ways. Quantum computation seems to provide a counter example to this thesis. Quantum computers use programs that can run on superpositions of input states, rather than just one such state. This "massive parallelism" can, sometimes, be used to speedup computations. The most dramatic example, so far, is Shor's quantum algorithm for factoring numbers that runs in polynomial time. It is widely believed that no TM can factor numbers (into their prime components) in so few steps. The paper will survey these developments and their implications for the "Physical Church -Turing Thesis."

Anya Plutynski *University of Pennsylvania*

Modeling Evolution in Theory and Practice

The discussion of models in philosophy of science has historically revolved around the question of whether models in the sense of metaphors or analogies are dispensable or critical to prediction and explanation. Today most philosophers of science accept that models are important to theorizing, but the focus has been primarily on mathematical models. Recent work on material, analogical, and otherwise non-mathematical models requires philosophers of science to reconsider the role of these types of models in scientific theory and practice. This paper discusses how biologists use non-mathematical models and argues that the semantic approach to evolutionary theory must accommodate these diverse types and functions of models.

Stathis Psillos *University of Athens*

Is Structural Realism Possible?

This paper examines in detail two paths that lead to Structural Realism (SR), viz. a substantive philosophical position that places structural constraints on the knowability of the world. The 'upward path' is any attempt to begin with empiricist premises and reach a sustainable realist position. (It has been advocated by Russell, Weyl and Maxwell among others). The 'downward path' is any attempt to start from realist premises and construct a weaker realist position. (It has been recently advocated by Worrall, French and Ladyman). The paper unravels and criticises the metaphysical presuppositions of both paths to SR. It questions its very possibility as a substantive—and viable—realist thesis.

Hans Radder *Vrije University*

Primitive Rays And Aetherial Air: On the Impossibility of Theory-Free Experiments

In this paper, I offer a differentiated philosophical interpretation of the relationship between experiment and theory. The claims that all scientific experiments are theory guided or that all experiments are explicit tests of existing theories about the objects in question, prove to be implausible. Yet theories are important for experimental practice for two reasons. The (immediate or later) significance of experiments is affected by the theoretical context in which they are situated. Moreover, performing and understanding experiments depends on a theoretical interpretation of what happens in realizing the experimental process. Through an examination of Newton's prism and Boyle's air-pump experiments, the last point is argued here in detail. It goes both against explicit claims made by some philosophers of experiment and against possible empiricist conclusions that might be drawn from such claims.

Athanasios Raftopoulos *University of Cyprus*

Reentrant Neural Pathways and the Theory-Ladenness of Perception

In this paper I argue for the cognitive impenetrability of perception by undermining the argument from reentrant pathways. To do that I will adduce psychological and neuropsychological evidence showing that (a) the early vision processing is not affected by our knowledge about specific objects and events and (b) that the role of the descending pathways is to enable the early-vision processing modules to participate in higher -level visual or cognitive functions. My thesis is that a part of observation, which I will call perception, is bottom-up and theory neutral, and can play the role of ground in which a naturalized epistemology could be built and relativism be avoided.

Robert C. Richardson *University of Cincinnati*

Chance and Indeterminism in Evolutionary Explanation

Explanations in evolutionary biology are probabilistic. Some philosophers such as Rosenberg (1988, 1994) and Horan (1994) argue that this indeterminism in evolutionary explanation is not fundamental. Appeals to chance in evolutionary explanation are merely epistemological, and can be dispensed with in favor of more fundamental deterministic explanations. Others such as Brandon and Carson (1996) press that the appeal to chance in evolutionary explanation is fundamental to evolutionary biology. These discussions fail to recognize the

grounds for chance and indeterminism in evolutionary explanation. There are sound reasons for maintaining that evolutionary explanations are irreducibly probabilistic, and autonomous.

John T. Roberts *University of North Carolina*

Undermining Undermined: Why Humean Supervenience Never Needed to be Debugged (Even If It's a Necessary Truth)

In the mid-1980s, David Lewis, the great champion of Humean supervenience (henceforth HS), feared that his beloved thesis might fall at the hands of chance. This was because of very strange phenomena that have come to be known as undermining futures (Lewis (1986a, xiv-xv)). The existence of undermining futures appears to be implied by any account of chance that is consistent with HS. Lewis's fear was that the existence of undermining futures, together with the Principal Principle — a thesis he took to be unassailable — entailed a contradiction. This problem was so troubling to Lewis that he dubbed it the big bad bug (Lewis(1986a, xiv)). There are two strategies that may be employed in attempting to save HS from the bug. The first strategy involves accepting the argument that derives a contradiction from HS together with the Principal Principle, and rejecting the latter. Since, as Lewis argues, the Principal Principle seems to be intimately tied up with our ordinary understanding of chance, such strategies arguably must be somewhat conceptually revisionary. John Halpin (1994), Ned Hall (1994), Michael Thau (1994), and Lewis (1994) himself have advocated versions of this strategy. The other strategy is to try to block the argument used to derive the contradiction. Peter Vranas (1998) has used a version of this strategy. Vranas's objection to the derivation depends crucially on the claim that HS is put forward by Lewis as a contingent truth rather than a necessary one. Vranas's argument successfully rescues HS understood in this way, but it leaves the stronger claim that HS is necessarily true in the clutches of the bug. This stronger version of HS, though, is of interest as well, and many of us actually find it more plausible than Lewis's own view: The considerations that motivate HS in the first place seem to many of us to motivate the claim that HS is necessarily true. In this paper I will argue that the derivation of the contradiction can be blocked without appeal to the contingent status of HS. This strategy will require a slight modification to Lewis's formulation of the Principal Principle, but this modification will not involve any revisionism about our concept of chance. Indeed, I will argue that this modification is motivated by the very reasons Lewis himself gives for accepting the Principal Principle in the first place. The upshot is that even those who view HS as necessarily true, and who do not want to engage in revisionism about the notion of chance, have nothing to fear from the bug.

Kristina Rolin *University of Helsinki*

Rational Grounds for Trust in Science

Whereas philosophers of science agree that trust plays an epistemic role in science, they are divided by the question: When is it rational for one scientist to trust another scientist? I argue that neither John Hardwig nor Philip Kitcher provide an adequate account of reliable testimony. Hardwig's account leaves room for systematic gender bias in perception of intellectual character. Kitcher's account is able to counter such bias more efficiently than Hardwig's but the method of direct calibration cannot be the sole foundation of epistemic authority. It has to be supplemented with a method that evaluates the testifier's epistemic resources. Epistemic resources should be understood in a broad sense to include those social arrangements that create opportunities for inclusive and responsive dialogue in science.

William A. Rottschaefer *Lewis and Clark College*

The Scientific Naturalization of Ethics

I outline a program for the scientific naturalization of ethics, focusing on metaethics and the sciences of biology and psychology. I suggest that metaethical questions can be framed in terms of questions about the nature, acquisition, activation, justification and function of moral agency. I present a model of moral agency based on current theories and findings in human sociobiology, developmental psychology, operant theory and social cognitive theory. In particular, I propose a selectionist model, based on natural, behavioral, and social/cultural selection, to explain the origin, development, and operation of moral agency.

Robert Rynasiewicz *Johns Hopkins University*

Definition, Convention, and Simultaneity: Malament's Result and Its
Alleged Refutation by Sarkar and Stachel

The question whether distant simultaneity (relativized to an inertial frame) has a factual or a conventional status in special relativity has long been disputed and remains in contention even today. At one point it appeared that Malament (1977) had settled the issue by proving that the only non-trivial equivalence relation definable from (temporally symmetric) causal connectability is the standard simultaneity relation. Recently, though, Sarkar and Stachel (1999) claim to have identified a suspect assumption in the proof by defining a non-standard simultaneity relation from causal connectability. I contend that their

critique is based on a misunderstanding of the criteria for the definability of a relation, a misunderstanding that Malement's original treatment helped to foster. There are in fact a variety of notions of definability that can be brought to bear. They all, however, require a condition that suffices to secure Malament's result. The non-standard relation Sarkar and Stachel claim to be definable is not so definable, and, I argue, their proposal to modify the notion of "causal definability" is misguided. Finally, I address the relevance of Malament's result to the thesis of conventionalism.

Eric R. Scerri *University of California Los Angeles*

The recently claimed observation of atomic orbitals and some related philosophical issues

The main thrust of the paper concerns a theoretical and philosophical analysis of the claim made in September 1999 that atomic orbitals have been directly imaged for the first time. After a brief account of the recent claims the paper reviews the development of the orbit and later orbital concepts and analyzes the theoretical status of atomic orbitals. The conclusion is that contrary to these claims, atomic orbitals have not in fact been observed. The non-referring nature of modern atomic orbitals is discussed in the context of Laudan's writings on realism, the success of theories and whether or not scientific terms refer. I conclude that the failure to observe orbitals is a good prima facie case for divorcing the success of theories from the question of whether their central terms refer. The added relevance of this case is that it concerns a current and highly successful theory.

Oliver Schulte *University of Alberta*

Inferring Conservation Principles in Particle Physics: A Case Study in Reliable and Efficient Inquiry

This paper applies learning-theoretic analysis to an inductive problem that arises in particle physics: how to infer from observed reactions conservation principles that govern all reactions among elementary particles. I describe a reliable inference procedure that is guaranteed to arrive at an empirically adequate set of conservation principles as more and more evidence is gathered. In certain circumstances, finding an empirically adequate conservation theory requires positing hidden particles. The paper describes learning-theoretic conceptions of empirical success in addition to reliable convergence to a correct theory, which determine an essential unique optimal inductive procedure for the particle dynamics problem.

M. J. Schervish *Carnegie Mellon University*

T. Seidenfeld *Carnegie Mellon University*

J. B. Kadane *Carnegie Mellon University*

Degrees of Incoherence applied to Statistical Hypothesis Testing at a Fixed Level

It has long been known that the practice of testing statistical hypotheses at a constant level, e.g. at the conventional .05 alpha-level, regardless of the probability distribution of the test data, is not consistent with Bayesian theory. It is not generally consistent with Bayesian inference, as Harold Jeffreys argued more than 70 years ago. Nor is it generally consistent with maximizing subjective expected utility, as Dennis Lindley and L.J. Savage argued in the more recent past. According to deFinetti's "Dutch Book" argument, some betting strategies that violate subjective expected utility theory also admit sure losses, i.e. they are incoherent in deFinetti's sense of that term. That is, such betting policies are susceptible to sure losses when applied in deFinetti's zero-sum betting game. Note that deFinetti's criterion is dichotomous. Provided that you offer (fair) betting odds for wagering in his game, either you are susceptible to a Dutch Book and your odds are incoherent, or else your betting odds are immune to a Book; they are coherent and correspond to a (finitely additive) probability function for events. In this paper we generalize deFinetti's dichotomous criterion to include rates of incoherence. Not all "Books" are equally incoherent, we maintain. We offer several indices for gauging degrees of incoherence. Moreover, we allow one-sided betting, where the bookie who proposes acceptable odds may use different odds when betting on an event versus when betting against that event. We apply this theory of the degree of incoherence in betting to evaluate further the Bayesian criticism that statistical hypothesis testing at a fixed level is incoherent. We show how to interpret statistical hypothesis tests, as bets in deFinetti's game, in terms of their error probabilities. Thus, the degree of incoherence of statistical tests is expressed in terms of their operating characteristics, as is appropriate for a non-Bayesian assessment of such tests. Also, we contrast the degree of incoherence of different proposals for adjusting the alpha-levels of statistical hypothesis tests as a function of their sample sizes.

Kristin Shrader-Frechette *University of Notre Dame*

Radiobiological Hormesis, Methodological Value Judgments, and Metascience

Scientists are divided on the status of hypothesis H that low doses of ionizing radiation (under 20 rads) cause hormetic (or non-harmful) effects. Military and industrial scientists tend to accept H, while medical and environmental scientists tend to reject it. Proponents of the strong programme claim this debate shows that uncertain science can be clarified only by greater attention to the social values influencing it. This paper casts doubt on their claim by analyzing 5 measurement uncertainties, as well

as 7 methodological value judgments, relevant to H. Using criteria of internal and external consistency, as well as predictive power, it argues that metascience helps resolve this debate. And if so, then value-laden, policy-relevant science may need, not only more attention to social values in order to resolve and to clarify disputes, but more traditional philosophy of science analysis. If this paper's thesis holds in the very politicized "hard case" of radiation hormesis, then it suggests that the metascientists may be right about what is often necessary to clarify scientific disputes.

Sergio Sismondo *Queen's University*
 Nicholas Chrisman *University of Washington*

Deflationary Metaphysics and the Natures of Maps

Scientific theories are maps of the natural world. This metaphor is often used as part of a deflationary argument for a weak but relatively global version of scientific realism, a version that recognizes the place of conventions, goals, and contingencies in scientific representations, while maintaining that they are typically true in a clear and literal sense. By examining, in a naturalistic way, some relationships between maps and what they map, we question the scope and value of realist construals of maps and by extension of scientific representations. Deflationary philosophy of science requires more variegated metaphysical stances.

Edward Slowik *Winona State University*

Descartes' Science, Holism, and the Mechanical Philosophy

In recent treatments of "holism" in the history of science, Descartes' natural philosophy is often judged to be a paradigm instance of a "mechanistic" and reductivist scientific approach. This essay, on the contrary, will challenge this view by exploring various aspects of Descartes' conservation principle for the quantity of motion (size times speed), especially its largely neglected function as a measure of both durational motion and instantaneous "tendencies towards motion". Despite the prevailing consensus, it will be demonstrated that an underlying non-local, or holistic, element is essential to a full understanding of the conservation principle's development and intended operation.

Kent W. Staley *Arkansas State University*

What Experiment Did We Just Do?: Counterfactual Error Statistics and Uncertainties about the Reference Class

Experimenters use pre-trial planning to ensure that they will be able to draw

reliable evidential conclusions on the basis of the outcome of their experiment. Sometimes such pre-trial planning fails, however. Experimenters then may try to use after-trial strategies for getting around the problems introduced by failure to adhere to pre-trial strictures. I discuss a general type of situation of this sort, in which failing to adequately predesignate the choice of test statistic leaves experimenters uncertain as to how they ought to characterize the experiment that they have done, and propose a method for potentially drawing reliable results from data even in the face of such uncertainty. In such a situation, the calculation of statistical significance becomes impossible to calculate reliably. Significance calculation requires that the experiment performed be specified, which in turn determines the reference class to be used in calculating the probability of the test result that obtained under the assumption of the null hypothesis. In the error-statistical account of experimental reasoning, such significance calculations are central because of the close relationship between significance and the error-statistical concept of severity. I propose an extension of error-statistical methods for assessing evidence for application to situations of uncertainty regarding the choice of reference class for calculating significance. The method uses calculations of apparent significance based on counterfactual choices of reference class. That is, experimenters using this method employ a single body of data, and ask what would have been the significance of the result that they would have obtained with that data, under the assumption of a variety of different test specifications. In this way, experimenters can determine how sensitive the apparent significance of the result obtained is to particular choices of test specification. I argue that this strategy can be used to determine whether the apparent severity with which the hypothesis in question was tested is an artifact of the failure of pre-trial planning. In particular, the method outlined may be appropriate to situations in which pre-trial precautions against biasing the test toward a particular result fail, but experimenters nevertheless wish to regain the ability to draw reliable conclusions from the data at hand. I illustrate this approach with an example from the search for the top quark conducted by the Collider Detector at Fermilab collaboration in the early 90s.

P. Kyle Stanford *University of California, Irvine*

Refusing the Devil's Bargain: What Kind of Underdetermination Should We Take Seriously?

Advocates have sought to prove that underdetermination obtains because all theories have empirical equivalents. However, algorithms for generating empirical equivalents simply exchange underdetermination for existing philosophical chestnuts, while the few convincing examples of empirical equivalents will not support the desired sweeping conclusions. Underdetermination does not, however, depend on empirical equivalents: our warrant for current theories is equally undermined by presently unconceived

alternatives as well-confirmed by merely all actual evidence, so long as this transient predicament recurs for each theory and body of evidence we consider. The historical record supports the claim that this recurrent, transient underdetermination predicament is our own.

Daniel Steel *University of Pittsburgh*

Bayesian Statistics in Radiocarbon Calibration

Critics of Bayesianism often assert that scientists are not Bayesians. The widespread use of Bayesian statistics in the field of radiocarbon calibration is discussed in relation to this charge. This case study illustrates the willingness of scientists to use Bayesian statistics when the approach offers some advantage, while continuing to use orthodox methods in other contexts. Such an eclectic and pragmatic use of statistical methods casts doubt on inferences from the use of a method to a strong commitment to principles underlying the method.

Alex Viskovatoff *University of Pittsburgh*

Economics and Kant's Philosophy of Science

According to Kant's philosophy of science, there are three methodological components to scientific theory appraisal: those of probability, possibility, and unity. Common views of scientific method, influenced by empiricism, usually only recognize the first. Because physical phenomena are governed by mathematical laws, this is not too harmful in the case of physics. Because social phenomena do not exhibit laws comparable to the ones in physics however—so that inductive methods are only of limited effectiveness for theory appraisal—this oversight is devastating in the case of economics: it is left with no adequate criteria for theory selection. The two other methodological components, in addition to clarifying the reservations of many regarding economics' scientific status, can prove useful as a guide to the construction of valid economic (and social) theory.

Carl G. Wagner *The University of Tennessee*

Old Evidence and New Explanation III

Jeffrey (1991, 1995) has devised a probability revision method that increases the probability of hypothesis H when it is discovered that H implies previously known evidence E. Wagner (1997, 1999) has generalized Jeffrey's method to the case of uncertain old evidence and probabilistic new explanation, based

on the principle that explanation-based revisions should preserve certain Bayes factors. A plausible alternative principle dicatates that observation- and explanation-based revisions should commute. One formulation of the latter principle is equivalent to the uniformity of Bayes factors, but another is not. This paper initiates a study of these competing revision principles.

Marcel Weber *University of Hannover*

Determinism, Realism, and Probability in Evolutionary Theory: The Pitfalls, and How to Avoid Them

Recent discussion of the statistical character of evolutionary theory has centered around two positions: (1) Determinism combined with the claim that the statistical character is eliminable, a subjective interpretation of probability, and instrumentalism; (2) Indeterminism combined with the claim that the statistical character is ineliminable, a propensity interpretation of probability, and realism. I point out some internal problems in these positions and show that the relationship between determinism, eliminability, realism, and the interpretation of probability is more complex than previously assumed in this debate. Furthermore, I take some initial steps towards a more adequate account of the statistical character of evolutionary theory.

Steve Weinstein *Princeton University*

Remarks on the Conventionality of Simultaneity

A recent paper of Sarkar & Stachel (1999) argues that Malament's (1977) proof, that there is only one simultaneity convention for special relativity that can be defined in terms of the causal structure, rests on a dubious assumption, namely that time has no intrinsic direction. Relaxing this assumption, Sarkar and Stachel use Malament's framework to construct alternative simultaneity conventions. In this paper, I argue that although the Sarkar and Stachel conventions satisfy their criteria, the conventions are deeply flawed, and suggest that the original criteria with which Malament works should be augmented.

Robert A. Wilson *University of Illinois, Urbana-Champaign*

Group-Level Cognition

David Sloan Wilson has recently revived the idea of a group mind as an application of group selectionist thinking to cognition. Central to my discussion of this idea is the distinction between the claim that groups have a psychology

and what I call the social manifestation thesis—a thesis about the psychology of individuals. Contemporary work on this topic has confused these two theses. My discussion also points to research questions and issues that Wilson’s work raises, as well as their connection to externalist conceptions of the mind familiar since the work of Putnam and Burge.

Eric Winsberg *Northwestern University*

Simulations, Models, and Theories: Complex Physical Systems and their Representations

Using an example of the computer simulation of the convective structure of a red giant star, this paper argues that simulation is a rich inferential process, and not simply a “number-crunching” technique. The scientific practice of simulation, moreover, poses some interesting and challenging epistemological and methodological issues for the philosophy of science. I will also argue that these challenges would be best addressed by a philosophy of science that places less emphasis on the representational capacity of theories (and ascribes that capacity instead to models) and more emphasis on the role of theory in guiding (rather than determining) the construction of models.

K. Brad Wray *University of British Columbia*

Science, Biases, and the Threat of Global Pessimism

Philip Kitcher rejects the global pessimists view that the conclusions reached in inquiry are determined by the interests of some segment of the population, arguing that only some inquiries, for example, inquiries into race and gender, are adversely affected by interests. I argue that the biases Kitcher believes effect such inquiries are operative in all domains, but the prevalence of such biases does not support global pessimism. I argue that in order to address the global pessimists’ concerns, the scientific community needs criticism from people with diverse interests and background assumptions. Kitcher fails to see this because he fails to recognize the social nature of scientific inquiry and the constructive epistemic role that our differences can play.

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