History of Science Society Annual Meeting
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Session Abstracts

Alphabetized by Session Title. Abstracts only available for organized sessions.
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Aesthetics and Politics: Towards Building Relationships between Media Studies and History of Science

Abstract: This session will explore the political implications of aesthetics with an eye towards furthering the ongoing conversation between media studies and the history of science. Each of these papers engages with a central moment or theme in the history of science and technology and analyses it through an interdisciplinary framework. Our papers are all linked by a central concern with the relationship between the embodied self and political and socials structures dominated by scientific and technological rhetoric. We all explore issues of design, the visual, images, and imagination in order to begin to build a new methodology around mediation, politics, and aesthetics in the scientific imaginary.

All at Sea? Oceanography and Geopolitics in the Twentieth Century

Abstract: Inspired by Ronald Doel's call for more critical analysis of the links between physical scientists and 'environmental' knowledge, specifically the desire to control as well as observe the earth, this panel examines the interface between oceanographers and the political/economic contexts in which they worked during the twentieth century. Lajus uses the under-examined history of Soviet oceanography to explore the role of major international projects -- notably the 1932-33 International Polar Year – in shaping a disciplinary community, as oceanography became an asset to state action in Arctic environments. Roberts argues that the oceanographic career of Hans Pettersson (best known to historians of science for his work in nuclear physics) reveals that the massive influx of money during the 1950s produced new geographies of patronage, most notably international networks with heavy American state influence. Voyages of discovery under Nordic flags were replaced by more prosaic surveillance with value to statecraft. Turchetti examines one of the most important of these networks – the NATO sub-committee on oceanography – showing that its rise was driven by military-strategic utility, and that its fall was connected to the growing importance of 'environmental' concerns (as distinct from strategic surveillance of environments). Sörlin's commentary will ask how these perspectives add nuance to histories of the environmental sciences, with particular emphasis on the interplay between state funding and environmental control.

Bodies, Colonies, and Stem Cells

Abstract: Stem cells are usually viewed as recent biotechnologies, having emerged primarily from in-vitro fertilization experiments conducted in the 1960s and 1970s. Our aim is to complicate this history by situating stem cells within a strand of biological thought in which the metazoan body is viewed as a colony of cells. The session will bring together an interdisciplinary panel to explore both the historical roots of the 'colonial' metaphor (in the work of August Weismann and Ernst Haeckel, among others) and the implications of the metaphor in contemporary stem cell science and policy-making. Exploring the history of biology in both the nineteenth and twentieth centuries, the role of metaphor in science, the impact of biotechnologies, and science policy, this panel would have a wide appeal amongst historians of science. Placing stem cells within this broad historical and metaphorical frame helps to explain some of their disruptive implications for our understanding of human life and its boundaries. Rieppel's paper will focus on the genesis of Weismann's germ/soma distinction and how it relates to his evolutionary theory of metazoan senescence. Stevens will elaborate the use and implications of the colonial metaphor in stem cell science, exploring their role in constructing the stem cell as at once a bodily and extra-bodily entity. Hurlbut's paper will draw out some of the implications of the parts-versus-wholes problem for public reasoning and policy discussions around embryo-related research. Fagan's commentary will utilize her expertise in the philosophical ramifications of stem cells in order to draw together these themes.

Brave New World: The Culture of Chymistry in Early Modern England and America

Abstract: Chymistry, the pre-modern term for alchemy, held a significant place in the emerging experimental sciences as a discipline that challenged traditional knowledge systems by presenting a new research paradigm for understanding and manipulating nature. Moreover, early modern society understood chymistry as an expression of "modern" thinking, a harbinger of a new age. With this premise, the four papers in this session explore the theory and application of chymistry on both sides of the Atlantic, their diverse views encompassing the ideals and realities of its practice: John Dee's scientific and magical ideas concerning the uses of American nature in terms of Elizabethan empire-building; the evolution of a colonial health care system in New England as seen through John Winthrop Jr.'s iatrochemical medical practice; the trans-Atlantic career of the seventeenth century minister and alchemist John Allin as a product of Anglo-American Puritan culture; and the impact of iatro-medical discourse on shaping early modern chymical philosophy and practice. In one sense, these narratives reflect facets of profound changes affecting Western culture over the course of the sixteenth and seventeenth centuries, engendered by geographical and intellectual discoveries. Equally, the papers cohere to illuminate the interplay between a shifting cultural environment and an intellectual arena in flux. From this transverse slice into the past, this panel seeks to expand scholarly discourse around the meaning and use of early modern science in the Old and New World, and identify enduring strands of influence.

Bringing Science to the Public: What Can the Science Studies Scholar Do?

Abstract: As debates in the United States over the reality of global warming and the validity of evolution by natural selection have demonstrated, the American public has a strong interest in the role of science in society. Historically, scientists have felt compelled to educate the broader public about science and apply their expertise to societal and political matters. Historians and other science studies scholars are often as well-suited as scientists, and in some cases probably better equipped, to contribute to general education, science education, and science policy. Armed with an appreciation of science and its interactions with society, scholars of science studies see situations differently than scientists and other professionals. This begs the question: How can science studies contribute to general education, science education, and science policy in the United States and across the globe? This panel discussion brings together prominent scholars who have experience bringing scientific facts and information to the public and policymakers through the spoken and written word. They will present their perspectives on the role of science studies in providing accurate scientific information to a general audience and discuss ways that historians and other science studies scholars can contribute to bringing science to the public.

The Centennial of Mme Curie's Nobel Prize in Chemistry (2011, 1911) and its Social Significance

Abstract: This session reflects on the scholarly significance of the Centennial of Mme Curie's (2nd) Nobel Prize, (2011, 1911) declared the International Year of Chemistry (IYC-2011), by re/examining several inter-related themes on commemorative practices, women in science, and comparative history of science. The changing commemorative practices for Mme Curie and her discoveries of radium and radioactivity in the 20th century are examined by Pnina G. Abir-Am. Robert W. Seidel examines the transition from natural to artificial radioactivity at the Curie Institute and its far reaching radiopharmaceutical ramifications before and after WW2. The complex collegial relationships of Mme Curie with female and male competitors from other countries, most notably Rutherford, are discussed by David Wilson, a biographer of Ernest Rutherford. Perspectives for the future on a century of historical research on women in science will be provided by Margaret W. Rossiter who just completed the 3rd volume in her trilogy, Women Scientists in America, 1972-2000. (Baltimore, 2011) Maria Rentetzi, a younger scholar and author of Trafficking Material and Gendered Research Practices: Radium Research in Early 20th Century Vienna (Columbia University Press, 2008) will serve as commentator.

Consuming Bodies: Statistics and the Human Sciences in the Nineteenth and Early Twentieth Centuries

Abstract: This session explores ways in which statistical knowledge and quantification generated new epistemological objects at the intersection of the natural, human and social sciences in the nineteenth and early twentieth centuries. Focusing on the consuming body, rather than the biometrically defined body, the papers study how the quantification of food as calories postulated a rational, "counting" subject, how dietary standards and metabolic norms emerged from the interaction of experiments on individuals and surveys of groups, and how different approaches to measuring human consumption created different objects of investigation. In the

process, the papers identify tensions between individual and statistical knowledge, experimental and anthropological approaches and discourses of quantification and of quality. This combination of scientific and statistical knowledge formed the basis for social policy and social reform, integrating bodies and groups into a network of measurements and norms.

Contesting Objectivity from Within in Mid-Twentieth-Century America

Abstract: For all that historians of science have written about the trajectories of the competing modes of objectivity, remarkably little attention has been devoted to the story of alternative theories of knowledge in the modern sciences. True, critics of strong objectivity claims often find a place in historical accounts of the social sciences. Even there, however, interpreters have failed to weave acts of epistemological resistance into a coherent narrative. Objectivity's critics appear as scattered, sporadic, and ineffective in our histories—the losers of modern epistemology. What if we instead foregrounded the dissenters in recounting the story of scientific knowledge? Collectively, these papers attempt to do just that. They do not claim that the shift of perspective validates any conclusion in particular about the relative appeal to working researchers of objectivity vis-à-vis its epistemological competitors. Yet they do suggest that examining the critics of objectivity can tell us much about the political benefits and dangers of such that epistemological stance. Focusing on the changing fortunes of John Dewey's instrumentalist view of knowledge (Jewett); the Jamesian lineage that influenced Gordon Allport, Roger Barker, and Ruth Benedict (Pandora); and epistemological debates in the crucible of the postwar atomic scientists' movement (Slaney), the papers suggest that it is high time historians of science give alternative epistemologies their due. They also point to the mid-twentieth-century United States as a time and place at which critiques of objectivity proved particularly compelling, and suggest a number of historical reasons why that was the case.

Costs and Benefits: Life Scientists and the Assessment of Wartime Technologies, from 1945 to the Vietnam War

Abstract: As historians have shown, the contributions of American scientists to national needs and military projects in World War II fundamentally changed their relationship to the government in the postwar decades. This panel explores the activities of a subset of life scientists who found themselves responsible for assessing either the benefits or hazards of new technologies developed as or derived from military research. This was a task that often entailed professional and political tensions: for example, how to balance enlistment into government activities with the perceived integrity of one's research. Where these two seemed to conflict, some actively broke with the national government to condemn the use of nuclear, biological, and chemical technology. Others broke with scientific consensus to promote the same. The papers show how such tensions manifested, and how scientists responded, in research into the effects of radioactive materials on the environment, in the contested use of atomic energy in agricultural improvement, and in debates over the use of chemical weapons with possibly serious social and ecological repercussions. Covering a range of institutions – including the U.S. military, the Atomic Energy Commission, the National Laboratories, and the International Atomic Energy Agency – the panel illustrates the ways in which researchers variously generated hope about the possible applications of military technology to social needs (as in the case of agricultural

improvement through atomic energy) and provided critical assessments of its impacts (in the case of environmental effects), while frequently serving certain political agendas.

Defending Science against Standardization

Abstract: The simple equation of standardization of the tools and methods of a scientific discipline and the accumulation of more reliable scientific knowledge has been justly complicated from several angles. Studies of disciplinary politics have pointed out that standards are not mere disinterested epistemological commitments but serve to bolster the status of a discipline and to enforce disciplinary hierarchies. The literature on model systems has revealed that some standard modes of investigation benefit as much from their particularity as their generality. Yet these approaches persist in presupposing that standardization, broadly construed, is a desideratum within scientific communities. This has not always been the case, even within the rationalizing culture of nineteenth- and twentieth-century sciences. "Defending Science against Standardization" will focus on resistance from within scientific communities to the standardization of instruments, units, images, names, theoretical armature, model systems, or procedures. It will address resistance that is primarily based on epistemological and/or practical (as opposed to political, economic, or cultural) grounds: practitioners think that they'll get more reliable knowledge more easily by resisting new standards or abandoning existing ones. Within a broad range of scientific disciplines – molecular biology, psychiatry, classical physics, organic chemistry – this panel will detail the circumstances and arguments of scientists who found that they were better off using idiosyncratic tools and treating their objects as capricious, unstable, nonstandard.

Divided Allegiances: Conflict and Compromise in the Republic of Letters from the Thirty Years' War to the French Revolution

Abstract: Bringing together historians of science, medicine, gender, religion and politics, this session traces the spatial contours and historical trajectory of early modern Europe's preeminent "social network": The Republic of Letters. The recent surge of interest in the Republic of Letters has brought to light the truly international character of information-gathering, communication, and knowledge-making in the pre-modern age. This session seeks to build on and to complicate that picture by focusing on the barriers faced by individual actors and subgroups within the Republic of Letters as they attempted to talk to one another across national, linguistic, confessional, gender, philosophical, and political divides. In some cases, these barriers were self-created, as when savants pursued private agendas and polemics that clashed with those of their interlocutors. Collectively, the four papers trace these conflicts and compromises across a broad territory: Italy, Switzerland, Germany, Britain, and France. Moving from the mid-seventeenth to the early-nineteenth century, they sketch out a map and a history of the ways that religion, war, nationalism, and sundry other commitments intruded into the supposedly neutral space of the Republic of Letters. In doing so, the session poses the question: What did it mean for science to be cosmopolitan in early modern Europe?

Doing Natural History

Abstract: After declining in popularity throughout most of the twentieth century, natural history is making a comeback. Increased public interest in biodiversity, climate change, and all things green is drawing attention to research that might be recognized as natural history. There has been little agreement, however, about the meaning of the term natural history, especially during the twentieth century. Practicing naturalists have dismissed the dictionary definitions for inaccurately portraying natural history as an amateur activity. Rather than ignoring the common perception of natural history, this session challenges three of its core assumptions: 1) natural history is only descriptive; 2) natural history is limited to collecting and collections; and 3) naturalists are generalists. This session tracks the history of doing natural history to show that academic natural history: 1) is theoretical and descriptive; 2) involves fieldwork, collections work, and experimentation; and 3) is conducted by specialists who depend on particular scientific tools and theories.

Emerging Methodologies in the Scholarship in History of Recent Science: Lessons from Food History

Abstract: This session brings together scholars using historical approaches within the field of food studies in order to examine a range of methodologies which are relatively novel in the history of science/technology including visual analysis, use of Geographic Information Systems (GIS), focus groups, and other approaches borrowed from the social and other types of sciences. These methods are particularly useful in a domain where source materials can be extremely limited due to the ephemeral nature of many of the everyday practices under examination and to the fact that topics in food history lie at the intersection of historical studies of science, health, medicine, and material and social cultures, among other areas. We illustrate how such methods have proven constructive for our research through a series of case studies from food history. In the papers as well as in the subsequent commentary and discussions, we explore how these methods might be adapted for those working in other areas of the history of science/technology, particularly contemporary or recent science, and on topics which focus on non-elite practices or other understudied areas within the sciences.

Establishing Networks of Nature's Experts: Environmental Science and State Power

Abstract: Producing and gathering scientific knowledge about nature has strengthened and challenged modern states. While some networks of nature's experts reify state power, other environmental authorities employ their knowledge to overturn conceptions of sovereignty and citizenship. This panel highlights the complicated roles that networks of scientists, state actors, transnational organizations, and local people have played in mobilizing environmental knowledge. Amrys Williams situates 4-H clubs in the U.S. Department of Agriculture's expanding role in the American countryside in the early twentieth century, where youths acted as federal agents, implementing biological ideas about development to create a "rural modernity" based on science and farming. Roger Eardley-Pryor analyzes an international NGO named Dai Dong that, in the late 1960s and early 1970s, used their Menton Statement to establish a global network of biologists and ecologists to challenge conceptions of sovereignty. However, Dai

Dong's clash with Third-World biologists on population issues reveals the limits of transnational environmental networks. Carmel Finley examines an international network of scientists whose efforts to determine the age of deep-water fish species called into question national harvest rates. Different nations' reactions to these discoveries, and the crash of rockfish stocks in 1996, shows how environmental knowledge may develop internationally but its implementation into policy remains decidedly national. These papers suggest that networks of natural scientists have played critical roles in implementing knowledge about nature to expand or oppose notions of modernity, development, citizenship, and state power. This panel is sponsored by the Earth and Environment Forum HSS interest group.

The Ethical and the Epistemological in Human Subject Research

Abstract: This session addresses the multivalant entanglements that existed between scientists and their subjects in American sciences. The panel engages with the different ways in which things such as money, Rorschach cards, and drugs channel the relationship between scientists and the participants in their studies. These entanglements were simultaneously ethical and epistemological. Morawski and Stark outline how differing forms of monetary exchange mediate the relationship between psychologists and participants. Bayer challenges the narrative equating modernity and secularization by examining the various forms of "channeling" which cut across religious and psychological practice. Campbell reveals the long-standing involvement of U.S. Public Health Service scientists in research on hallucinogenic drugs. In Pettit's paper, the experimental scientist becomes the clinician's and, in turn, the historian's, subject. Research on human subjects in psychology and medicine has generated rich but largely mutually exclusive historiographies and the aim of this panel is to begin to bridge this gap in the scholarly literature.

Federal Measures: Standardization of the Body throughout the 20th Century

Abstract: In their influential 2009 essay collection, Martha Lampland and Susan Leigh Star argued that "standards are phenomena worthy of study in their own right, from multiple social scientific points of view." While Lampland and Star's call for a multidisciplinary perspectives on standardization has been heeded, critical engagement between diverse academic fields on this topic is still severely lacking. This panel will weave together four aspects of how standardizing measures have influenced cultural conceptions of the body throughout the 20th century through the lenses of history of medicine, economics, women's studies and sociology. All four papers examine various aspects of how standards of weight and height are established and operate as valued norms: measuring tools as devices used in self-regulating rituals, military induction examinations as standard-establishing performances, pediatric check-ups as moments when standards are reified, and measurements as anthropometric instruments in assessing the past. Through this panel we hope to demonstrate how scientific medicine's standardization of height and weight measurements has profoundly influenced cultural concepts of healthy bodies. Kris Inwood et al. begin the discussion with a study of stature and living standards in the 1910s. Amanda Czerniawski then brings a theoretical perspective through a study of early height-weight charts and the relationship between standards to self-disciplining. Rachel Moran examines the extent to which physical standards for WWII draftees were actually enforced and what this says

about the limitations of standardization. Finally, Aimee Klask considers the implications of the standardization of measuring growth in clinical pediatrics. Beth Linker will moderate.

Floating Labs: Mobile Scientific Spaces and the Reconfiguration of Practice

Abstract: The role of laboratory spaces in shaping scientific practice has long been of interest in the history of science. This panel aims to extend and enrich this field of study by shifting the focus from traditional laboratories to laboratory spaces at sea, or floating labs. By looking at two floating labs and one submerged lab—the HMS Challenger in the 19th century and the Alpha Helix research vessel and Tektite habitat in the latter half of the 20th century—this panel will examine how laboratories at sea reconfigured laboratory practices, knowledge production, and the circulation of scientific products. These spaces, simultaneously isolated and highly mobile, shed light on the roles of voyaging, collection, confinement, preservation, and locality in laboratory work both at sea and on the shore.

Forum for the History of Science in America Business Meeting and Distinguished Scientist Lecture by Cynthia Beall, Distinguished University Professor, Case-Western Reserve University

Abstract: Dr. Beall is a physical anthropologist whose research focuses on human adaptation to high-altitude hypoxia, particularly the different patterns of adaptation exhibited by Andean, Tibetan and East African highlanders. Her current research deals with the genetics of adaptive traits and evidence for natural selection, with the role of nitric oxide in oxygen delivery at high altitude and with the human ecology of high-altitude Tibetan nomads. http://www.case.edu/artsci/anth/Beall.html.)

The Heidelberger Kreis of Scientists at Mid-Century: Teaching, Research, and International Fame

Abstract: The dramatic rise of the experimental sciences in Germany during the middle decades of the nineteenth century has been much studied, but a fully satisfactory understanding of this remarkable phenomenon has been elusive. Past approaches have been arguably too exclusively focused on single disciplines, or on unique sociocultural factors such as decentralized competition, the ideology of neohumanistic *Wissenschaft*, or state interest in promoting modernization. Historians need to pay closer attention to the interactivity between unique local circumstances and the agency of leading individual personalities. The University of Heidelberg provides a fine test case for the promise of such a more holistic assessment. Robert Bunsen arrived there in 1852, Gustav Kirchhoff in 1854, Hermann Helmholtz in 1858, and Hermann Kopp in 1864. Each of these personalities powerfully tested disciplinary boundaries while engaging in far-reaching research, attractive teaching, and effective public outreach. The result of their individual efforts, combined with their strong interpersonal connections, was the extraordinary rise in the world reputation of their university, especially for productive experimental research, and the transformation of the institution from essentially provincial to broadly cosmopolitan influence in the sciences. This ascendancy lasted until this Heidelberg

experimentalist circle slowly disintegrated with the gradual departures of these scientists during the last third of the century.

How Physicists Learned to Love Abstraction, From Helmholtz and Poincaré to Robb, Planck, and Einstein

Abstract: The rise of theoretical physics in Western Europe as an autonomous subdiscipline was facilitated, as Jungnickel and McCormmach observed in the 1980s, by a belief in the power of mathematics to bring forth intellectual mastery of nature, a belief that led to an ever-greater reliance on advanced mathematical techniques. Emblematic of such techniques is the use of Hamiltonian forms, introduced by Sir William Rowan Hamilton in 1834. The papers in this session explore the extensions and new uses found for Hamiltonian methods in the period from 1880 to 1921, and focus on how these abstract techniques came to embody the worldview of physicists. Tom Archibald's paper takes up Henri Poincaré's introduction of Hamiltonian methods in the domain of celestial mechanics, which formed the foundations of systems dynamics and chaos theory, but proved difficult to master. Marta Jordi's paper examines the history of covibrations in the domain of light-matter interactions in the late 19th-century, showing how this concept migrated from acoustics to electro-optics. Scott Walter's paper links Alfred A. Robb's optical theory of space and time (1914) to early-20th-century explanations of the formation of atomic spectra, via Robb's Cambridge training in Lagrangian dynamics. Similarly, Massimiliano Badino links Max Planck's abstract approach to the nascent quantum theory of gas (later taken up by Einstein) to his lifelong search for an absolute concept of entropy.

Late 20th Century Scientific Publics

Abstract: This panel explores alternative forms of scientific communication in the late 20th century from popular science aimed at scientists themselves to Playboy and science fiction. In his 2004 Keynote Address “Knowledge in Transit,” Jim Secord argued that the “centrality of processes of movement, translation, and transmission” characteristic of the history of reading offers historians of science opportunities to cross boundaries in the field and to speak to broader publics. Secord’s insights were followed by the 2009 ISIS Focus Issue on Popular Science that discussed the significance of scientific publics as an interpretive frame. We seek to build on scholarship in this popular turn by extending it to the United States in the Cold War era. We hope also to add methodological insights to studies of scientific publics by breaking down barriers between "practitioners" and "receivers." Such an inquiry reveals the extent to which scientists and engineers in the second half of the 20th century were frequent boundary-crossers as they shared and re-imagined their work in a variety of novel public forums.

Linking the Past and the Present: A Discussion of Collaboration Between Historians and Practitioners in the Classroom, the Field and the Laboratory

Abstract: This session builds upon established and ongoing scholarship about the pedagogical relationship between history and practice. An awareness of the history of science and its methods

certainly has the potential to make for better practice, yet history is not often incorporated into the teaching of STEM subjects. Brief presentations by historians of their pedagogy in this area will serve to open discussion of exciting opportunities for developing greater integration of history into the teaching of STEM subjects at the undergraduate level in the field as well as in the classroom and in the laboratory. Similarly we explore the benefits to historians of pursuing such collaborations.

Locating Emotions in the Body: Transnational Perspectives on the Treatment of Emotional Disorders in East Asian Medicine

Abstract: One of the fascinating features of traditional medicine in East Asia is the various ways that physicians have devised to address emotional disorders by treating underlying pathologies of the body. Although it is tempting to think of this holism as an intrinsic feature of East Asian medicine, the papers in this panel will show the complex histories of these therapies and how recent some of them are. Instead of simply comparing and contrasting treatments of emotional disorders across the major national traditions in the region - Chinese, Korean, and Japanese medicine, this panel will highlight the need for a broader perspective that also draws attention to the "transnational" or boundary-crossing flows of knowledge in the region. One of the key epistemic shifts that transformed medicine across the region beginning with the 17th century is a growing attention to the Liver as a key site for pathologies of constraint. Although doctors in each region developed unique approaches to the problem of constraint, the papers in this panel will also show that these solutions were motivated in large part by a new empiricist ethics that was sweeping the region. Interest in empiricism began with the late imperial movement in China, called evidential scholarship, to examine the authenticity of the classics through the techniques of philology. This empiricism was given new impetus, with its center in Japan, when Western science and medicine came to the region in the 19th century, leading to unique and innovative developments in medical practice across the region.

Mail Order Science

Abstract: In post-World War II America, science education collided with an increase in discretionary income, resulting in an interest in home science kits and numerous mail order companies willing to supply the demand. These kits appealed to a broad spectrum of learners, from children interested in how to blow things up to serious adult hobbyists. This panel explores the growth in home science kits, from chemistry and erector sets to microscopes and telescopes. By tracing the histories of these kits, this panel looks at the material culture of learning science. Sarah Scripps will survey the availability of popular science kits aimed at children and investigate how engineers and professional scientists added to the kits' authority by writing detailed instruction manuals. Gary Cameron will focus the discussion on adult hobbyists by looking at the dramatic rise in amateur telescope makers that was made possible through the availability of military surplus optical equipment. Allison Marsh will bridge the two papers by reporting on how inexpensive mail order kits can be integrated into a university history of science course. Eric Hintz will provide a commentary grounded in the Lemelson Center's

mission of promoting the teaching of invention and scientific experimentation as an iterative process. Because of the emphasis on material culture, this panel will have a show and tell component with objects.

Making Mathematics: Models, Machines, and Materialities

Abstract: The instruments and materials of mathematics are neither mere supplements to mathematical cognition nor pedagogical crutches later replaced by formal abstractions. Each paper in this session highlights the importance of tools and material culture to the historical development, validation, and dissemination of mathematical knowledge. The papers take an expansive approach to both mathematics and materiality, aiming to integrate historical analysis into broader debates surrounding extended cognition, the material culture of science, the instruments of pedagogy, and science as practice. The history of mathematics provides a rich setting in which to investigate the relationships among instruments, theories, and the validation and transfer of knowledge.

Moral Science

Abstract: Far from being solely concerned with facts, science historically has been characterized as a source of moral norms, a cause of moral crisis, and a competitor for moral authority. The lines drawn to connect scientific experiments, ideas, and education to questions of morality have been complex, contested, and contingent. What do these varying depictions of science, its moral implications, and the ways they have been marshaled by their advocates tell us about the social and cultural situatedness of the scientific enterprise? The three papers in this session take very different approaches at answering this question. Looking at Victorian Britain, Matthew Stanley investigates those advocates of general scientific education who promoted the moral improvement that learning science had on working men. Using J.D. Bernal's work as a departure point, Nasser Zakariya examines the calls to new ethics promoted by 20th century scientists such as Harlow Shapley and E.O. Wilson who adopted a synthetic approach to the question of science and morality. Also looking at the 20th century, Matthew Shindell reexamines the contentious Miller-Urey experiment in its Cold War context to revive what moral implications surrounded the experiment when it was performed, and to reveal what the experiment, when contextualized, can tell us about science and religion during the Cold War.

Migration of Scientists in Asia and the World

Abstract: Our scientific communities have become more globalized due to the increase in the number of non-Western participants, such as those from Asia. This panel examines this process from a historical perspective. It highlights the fluidity and rigidity of science in the age of mass migration, that is, the twentieth century. More specifically, the panelists explore the (trans)formation of science both despite and because of the migration of British, Chinese, and Japanese nationals—the carriers of scientific knowledge and culture. The panel's approach is national, transnational, international, and comparative. A series of cross-cultural analyses highlight the changing content, implications, and cultures of science as a function of humans

moving into and out of Asia. As a whole, the panel investigates the impacts of human traffic in science on the rise/demise of individual/group identity, nationalism, internationalism, and national security concerns in the home and host countries.

Natural History of the Heavens: Classification, Development and Structure in Nineteenth Century British Astronomy

Abstract: Thanks to his exhaustive sky surveys and speculations, William Herschel (1738-1822) successfully situated the question of the true construction of the heavens within the boundaries of acceptable research for nineteenth century astronomers. By casting his own investigations in the mold of a problem in natural history he offered his contemporaries and followers a rich new methodological and theoretical framework distinct from and complementary to that which drove the Newtonian quest to elucidate the mechanics of the celestial clockwork. Like natural historians in the life and geological sciences, some nineteenth century British amateur astronomers took up Herschel's call to sweep the sky in search of double stars, nebulae and other species of celestial phenomena in order to uncover the underlying plan for the construction of the heavens. Unable to scrutinize or dissect their quarry directly in the laboratory, observers followed Herschel's example and classified the specimens they amassed to discern patterns of distribution, morphology and development. In this session, presenters will examine John Herschel's search for examples of double stars, the effect of emerging theories of evolution and progressive development in other disciplines on the questions astronomers felt empowered to ask, and the changes in astronomical practice and theory that resulted after the spectroscope, an instrument long familiar to chemists and physicists, was introduced into the astronomer's toolkit.

New Perspectives in the Modern History of Madness and Psychiatry

Abstract: With psychiatrists in the United States busily debating revisions of the Diagnostic and Statistical Manual, it is an appropriate moment to consider the state of the historiography of madness, mental illness, and psychiatry. During the first half of the twentieth century, formal study of the history of psychiatry was largely the pastime of clinicians, whose writings were dominated by internalist and celebratory narratives. Over the course of the second half of the last century, the field has become a critical, trans-disciplinary enterprise inspired by, among other things, cultural and social history, social theory, ethnography, gender studies, the social study of race, science and technology studies, literary studies, and bioethics. As a result, historians have been drawn in recent years to a host of new topics and themes, including extramural care, imperialism and its legacy, war and medical treatment, the history of psychiatry after 1945, and the rise and growth of the psychopharmaceutical industry. In what promising new directions are historians of mental health and psychiatry moving today? Referring to individual case studies, panelists from Germany, Luxembourg, and the U.S. will explore some new methods, topics, and source materials for studying the modern history of madness and its treatment, : the study of material culture, film and its clinical uses, the appearance and disappearance of diagnostic categories, and the topography of forensic psychiatric work. Comments and discussion will focus on not only the advantages and limits of these approaches, but also the state of the field today.

New Views of the Antikythera Mechanism: A Geared Astronomical Computing Machine from the Second Century BCE

Abstract: In 1901, a geared astronomical device with Greek inscriptions was recovered from an ancient shipwreck. A century of scholarship, including intensive new work in the last decade, has resulted in general scholarly agreement about many of the features of the Antikythera mechanism. However, several important issues remain unresolved, including the provenance of the mechanism, its precise date, and the nature of its lost planetary displays. The papers in this session will set the Antikythera mechanism in context, address some of the unresolved issues and offer assessments of its significance for reconstructing the history of a formative stage of ancient Greek astronomy.

The Politics of Science in Federal Research

Abstract: In *The Politics of Pure Science*, Daniel S. Greenberg dispelled the myth of scientific purity and detachment by revealing the political processes that underpinned government funding of science from the 1940s to the 1970s. The relationship between science and politics has nevertheless had positive and negative results. Each paper in this panel identifies the consequences of multidisciplinary efforts to study controversial and politically charged research subjects. Grischa Metlay focuses on two areas of substance abuse prevention research prioritized during the 1980s: drinking and driving and the transmission of HIV/AIDS. Metlay shows how research programs in each area involved similarly pragmatic approaches to multidisciplinary research, even if work in each area supported divergent political priorities. Brian Casey explores the politics behind the unprecedented effort to study the philosophical and practical ramifications of the Human Genome Project with the Ethical, Legal, and Social Implications Program. Casey places this within the context of the National Institutes of Health's long history of bioethical reforms, motivated at times by both real and imagined scandals. Eric W. Boyle examines the politics behind the Congressional mandate to study the controversial subject of alternative medicine at the NIH in the early 1990s. While advocates have argued that this research promises to expand the horizons of health care and biomedical science, skeptics have maintained that this effort represents a political boondoggle. Each of these papers places pure and applied biomedical research since the 1970s under the microscope, demonstrating how federal research is often inextricably bound up with political priorities.

Pragmatism and the History of Science: James, Dewey, and Mead

Abstract: Making connections between philosophical and scientific work can be tricky business for historians - the danger comes in balancing actors' and analytic categories, and in elucidating the relationship between different "sorts" of ideas. This is especially true in the case of American Pragmatism, the precepts of which are indistinguishable from contemporaneous work in psychology and logic, and the founders of which were important scientific figures themselves. William James, John Dewey, and George Herbert Mead were all influential in academic disciplines (psychology, sociology, philosophy) as well as in the culture at large, where they worked to assimilate scientific finds and "habits of mind" to contemporary issues. Recently, scholars have begun to explore these connections as part of an effort to address historical and

philosophical problems of influence, demarcation, and meaning. This panel is part of this recent movement: by examining three figures central to both pragmatic philosophy and the scientific ideas on which it drew, these papers contribute to our evolving understanding of the relationship between different forms of cultural authority at the turn of the twentieth century. As these case studies coalesce into a composite portrait of the themes animating their protagonists, the panel as a whole should be of interest to both historians of relevant subfields (specifically histories of the human sciences and of philosophy of science) as well as those interested, generally, in the categories of "science" and "society," which were significantly reworked into familiar forms by the thinkers taken up by this panel.

Profit and the Public Weal: Science, Luxury and Commercial Society, 1700-1850

Abstract: In the intellectual history of the eighteenth century, historians have traditionally accorded an important place to the reevaluation of the relationship between the general welfare and the individual's pursuit of self-interest. This change in thinking is most famously associated with Adam Smith, who argued that general prosperity could best be achieved through each person's pursuit of his own individual desires. Along with new theories of commercial society came a reevaluation of older ideas about luxury; what had once been a moral failing now became a potential contribution to human progress. But enlightened thinkers (Smith included) also felt considerable ambivalence about self-interested behavior, and thought carefully about how one might reign in forms of selfishness that would corrode the social order. The many technical and agricultural innovations of the eighteenth century occupy an ambiguous and underexplored position in these eighteenth-century debates over luxury, self-interest and the general good. Things like lighthouses, new silver mines, and exotic new breeds of cattle shared with traditional "luxuries" several characteristics: they were expensive, rare, and hard to procure or build. But they were also imported or built under the aegis of enlightened patriotism; they were (at least in theory) meant to alleviate the sufferings of humanity in general, not just to give pleasure to the few. Our panel examines the rhetoric and practice of introducing technical or agricultural novelties in an attempt to better understand how the public authority of science interacted with the expansion and development market economies in this crucial transition period.

Public Places and Pictured Spaces: Putting Science on Display

Abstract: While historians are increasingly aware of the role played by visual culture in the study of nature, important questions arise when science itself, and not just its objects of study, becomes the subject of representation and display. It is easy to assume a straightforward relationship between an image and the thing it depicts, or between the use of imagery and the dissemination of knowledge, but while visual culture has shaped science profoundly, it has also complicated its practice in unexpected ways. This panel uses the theme of place -- public, private, geographical, conceptual -- to explore the complex relationship between science and visual culture. Maps, images, spectacle, and other forms of representation displayed more than the natural world to audiences -- they also displayed how different kinds of science worked, allowing contemporaries and historians alike to both query and critique the methodologies, assumptions, and practices that supported the study of nature. By examining a range of places and spaces, and by putting the visual culture of science into context, these papers consider the

ways in which that culture has changed how historical thinkers across a range of disciplines and periods have done science as well as how others have seen it.

Putting the Human into Human Genetics

Abstract: The history of human genetics, particularly after World War II, is rich with implications for complex issues such as eugenics and hereditary control, the clash of scientific vs. medical culture, ethical dilemmas related to human reproduction and genetic manipulation, and the role of human genomics in contemporary biomedicine. This session will bring together some of the leading scholars working on human genetics in the US and Britain to present original research on the laboratory and clinic, cytogenetics and biochemical genetics, genetic counseling, genetic testing and screening, and changing concepts of genetic disease. From distinct perspectives, panelists will trace the multiple and intertwining developments that helped to produce the interdisciplinary field of human genetics and to infuse genetics more broadly into biomedicine.

Revisiting Iconography: The Persistence and Circulation of Scientific Illustrations

Abstract: Iconography, the study of how canonical images persist through the centuries, has become a tedious tool of visual studies. When scholars pursue it for its own sake, it is oftentimes solely to determine the earliest source for a well-known image. In this panel, we propose to revisit how scientific images persist, travel, and gain new identities across historical, geographical and disciplinary boundaries. What are the material, financial, and intellectual reasons for the repeated copying of a scientific image? How does the deployment of the same image in a new historical context shape the development of science, both by establishing a disciplinary identity and by connecting divergent fields of scientific practice? In our interdisciplinary and transhistorical panel, an art historian, an early modern and a modern historian of science examine these questions in three different historical and scientific contexts. Jasper van Putten shows how Tycho Brahe reused his own, earlier woodcuts and emblems when printing the *Astronomiae instauratae mechanica* to present himself as a Christian scientist in search of a new patron. Daniel Margocsy examines how Renaissance artists' idealized images of horses would later serve as blueprints for breeding the perfect horse in the hippological treatises of early modern natural history. Finally, Ilja Nieuwland explores how visual representations of the prehistoric, half-bird and half-reptile Archaeopteryx subtly changed in the last 150 years as biologists reshaped the evolutionary boundaries between birds and reptiles.

Robert S. Westman's The Copernican Question (2011): A Symposium

Abstract: Robert S. Westman has just published a major book, entitled *The Copernican Question: Prognostication, Skepticism, and Celestial Order* (University of California Press, 2011). In it he argues a novel thesis based on extensive historical documentation and only hinted at in his earlier publications: the pervasive influence of astrology in the development of early modern science. Westman suggests that the work of canonical figures such as Copernicus, Kepler, Tycho Brahe and Galileo is unified by attempts to respond to skepticism about

astrological prognostication. The papers in this symposium will examine the contents of this long and rich book in detail and begin to articulate a scholarly response to Westman's new work. The symposium will conclude with a response by the author. In 1543, Nicolaus Copernicus publicly defended his hypothesis that the earth is a planet and the sun a body resting near the center of a finite universe. But why did Copernicus make this bold proposal? And why did it matter? The Copernican Question reframes this pivotal moment in the history of science, centering the story on a conflict over the credibility of astrology that erupted in Italy just as Copernicus arrived in 1496. Copernicus engendered enormous resistance when he sought to protect astrology by reconstituting its astronomical foundations. Westman shows that efforts to answer the astrological skeptics became a crucial unifying theme of the early modern scientific movement. Book website: *http://www.ucpress.edu/book.php?isbn=9780520254817*

Science and Commodities, Regions and Worlds: Revisiting the Historiography of "Colonial Science"

Abstract: This panel will revisit the historiographical category of "colonial science" by focusing on specific colonial commodities and the science associated with them that epitomize connections of the colony with the world. It will highlight flows and movements against the commonly considered tropes of statism, territoriality, and governmentality in presenting the histories of cinchona, cochineal cactus, and indigo. The colonial context is not erased in these papers. But rather the panelists complicate the context of colonial through an additional consideration of the contingencies arising from wider historical spaces. Colonialism was not immune to developments beyond its immediate purview. The panel argues that developments outside the immediate imperial domain could impact colonial history and developments within the colony could seek inspiration beyond the Empire and its broader global networks. Thus the science analyzed in these papers spotlights the latter's connections with regimes of knowledge flows and their multi-directionality. Goss studies cinchona and its derivative quinine to highlight the nature of forces that produced a prophylactic drug with global efficacy in the mid to late nineteenth century. Frey focuses on the failed attempt to introduce a cactus plant from Mexico to colonial India to culture the cochineal-yielding insect on them. Frey's analysis of resistance by the plant and the organism sheds light on the nature of enlightenment project of eighteenth century science. Kumar analyzes knowledge embedded in disaporas of indigo planters to highlight the genealogy of nineteenth century Bengal plantations among knowledge regimes in the West Indies, Central America, and South Carolina.

Science and Regulation in a Contaminated World Part I

Abstract: One of the major goals of the modern environmental movement has been to increase government regulation of pollutants, especially industrial chemicals. These papers address the various ways that science has been created and mobilized for this effort—and in the efforts by corporations to resist increased regulation. In this arena, scientific uncertainty has served as a technical challenge in formulating sound regulation, even as it has been used politically by adversaries of regulation. We focus on both American and European case studies, allowing for comparison of how the U.S. "threshold" approach differed from the tendency in Europe to rely on the precautionary principle. We also consider how new scientific knowledge has subverted

conventional assumptions, both in the area of regulatory toxicology (e.g., endocrine disruptors) and in environmentalism itself (the Ames test). Our papers and discussions will probe the intersecting roles of science, politics, policy, and public health that shaped debates about modernizing chemical regulations.

Science and Regulation in a Contaminated World Part II

Abstract: One of the major goals of the modern environmental movement has been to increase government regulation of pollutants, especially industrial chemicals. These papers address the various ways that science has been created and mobilized for this effort—and in the efforts by corporations to resist increased regulation. In this arena, scientific uncertainty has served as a technical challenge in formulating sound regulation, even as it has been used politically by adversaries of regulation. We focus on both American and European case studies, allowing for comparison of how the U.S. "threshold" approach differed from the tendency in Europe to rely on the precautionary principle. We also consider how new scientific knowledge has subverted conventional assumptions, both in the area of regulatory toxicology (e.g., endocrine disruptors) and in environmentalism itself (the Ames test). Our papers and discussions will probe the intersecting roles of science, politics, policy, and public health that shaped debates about modernizing chemical regulations.

Science and Spiritualism

Abstract: From the 1850s through the early decades of the twentieth century, spiritualism was one important response to the expansion and rise of scientific naturalism. Many followers of spiritualism found in séance phenomena empirical evidence for their beliefs. It was likewise compelling to naturalists and natural philosophers interested in exploring the role of the immaterial in the physical world, and who embraced a commitment to both religious faith and the naturalistic worldview. Among its prominent supporters were men of science such as William Crookes, Alfred Russel Wallace, George Henslow, and Oliver Lodge, and the important publisher and evolutionist Robert Chambers. Equally prominent were some of spiritualism's most vocal critics, including Michael Faraday, William Carpenter, and Edwin Ray Lankester. Spiritualism was a controversial movement that highlighted many broader philosophical and sociological issues about the natural world and how to study it. Ontological, epistemological, and methodological conflicts between spiritualist advocates and their critics, along with a growing push for and against expanding the authoritative bounds of the naturalistic worldview, made spiritualism phenomena paradigmatic test cases for the rising professionalization of science and the widening divide between science and religion. Our panel seeks to elucidate some of these broader issues through three case studies from the spiritualist movement. While each of our papers takes a respectful and sympathetic approach, we analyze our subjects critically from a variety of perspectives.

Scientific Periodicals in Great Britain, 1785-1914

Abstract: Most modern observers consider the scientific periodical to be an essential, even

defining, feature of modern science, and yet it is only recently that scholars have begun to examine scientific magazines and journals as historical objects in their own right. The four papers in this panel explore the development of scientific periodicals in Great Britain from the late eighteenth century through the early twentieth century, a chronological scope that provides both detailed case studies of particular publications and a wide-ranging view on the changes in science publishing that took place between the French Revolution and World War I. The panelists will explore issues such as the motivations behind the foundation of new periodicals, the way the goals of the editors and contributors influenced the development of periodicals, the types of knowledge various publications sought to disseminate to their readers, the visual epistemology of different publications, and the role that particular journals fulfilled for members of developing scientific communities. Publications discussed will include *Nicholson's Journal*, *The Kaleidoscope*, *Knowledge*, and *Nature*.

Sensing Tones: Hermann von Helmholtz at the Intersection of Sound, Music, and Science

Abstract: Hermann von Helmholtz's seminal investigations connect physics and physiology with music and sound, yet his relation to music has remained relatively little studied, compared to other aspects of his work. Both a source of crucial sonic examples and an autonomous art whose powers touch on science, music for Helmholtz was embedded in rich cultural and scientific contexts, which this session explores. The papers presented here investigate how Helmholtz's ideas about music were rooted in contemporary musical culture (Alexandra Hui), how they interacted with vocal practice through his work in laryngoscopy (Benjamin Steege), how they take up and continue on the issues discussed in experimental physiology (Julia Kursell), and how they inform his intervention in the theory of geometry and space, crucial for subsequent developments in twentieth-century science and mathematics (Peter Pesic). A commentary will be provided by Myles Jackson, author of one of the few major studies so far on the relationships between music and science during the nineteenth century.

Solid State Science in the Twentieth Century: Major Trends through a New Lens

Abstract: This panel has two objectives. First, it communicates how the solid state sciences, with the communities and institutions that formed around them, can both inform and challenge conventional thinking about major trends in the history of twentieth-century physics and chemistry. Second, it galvanizes a group of scholars with shared interests, promoting future research and collaboration. To accomplish these goals, the panel presents a cross-section of current research in the history of the solid state sciences. These talks range from the quantum theory of solids in the 1920s and 1930s to the growth of institutions dedicated to solid state in the later twentieth century; they discuss the American and European contexts from the perspectives of multiple disciplines. A broad presentation demonstrates the extent to which this understudied enterprise can contribute to our understanding of twentieth-century science and identifies directions for further research. Too few scholars have responded to the call issued by the authors of *Out of the Crystal Maze* (1992) to deepen historical understanding of solid state science and its impact. This panel takes up that challenge by examining solid state science's unwieldy but rich diversity. It reveals how sophisticated historical exploration of the field demonstrates the

ways in which solid state science has shaped twentieth-century science, its institutions, and its politics.

The "State" of Science and Religion: Ingenuity and Institution in the Age of Galileo and Kepler

Abstract: In this session, we explore science and religion and their complex relation during the political crisis of seventeenth-century Europe. By focusing on the revolutionary figures of Galileo and Kepler, we cast new light on the ideas and events that shook the very foundations of European scholarship and society. In the first paper, Aviva Rothman discusses Kepler's unpublished dialogue on the calendar reform and his view of the mathematician as "a vital mediator and conciliator" in the resolution of political and confessional conflict. In the second paper, Patrick J. Boner presents a case of censorship that forced Kepler to revise his account of the comet of 1607 according to the wishes of the theological faculty at the University of Leipzig. Next, Jorge M. Escobar explains Kepler's two conceptions of geometry, their coherence in his natural philosophy, and how they improve our understanding of Kepler's place in the history of philosophy. Finally, Michael H. Shank discusses the different fates of Galileo and Campanella and what they tell us about the political motives that played out in the Galileo Affair.

Technoscience Exchanges between Latin America, Europe, and the United States in the "Short Twentieth Century": Comparative Studies of Knowledge and Practice Exchanges

Abstract: Exchange in science and technology among Latin American countries and Europe in the 19th and early 20th centuries as well as the earlier European science expeditions are well studied topics in the history of science; Lewis Pyenson's *Cultural Imperialism and Exact Sciences* and Mauricio Nieto's *Remedios para el Imperio* are good examples of such literature. However, with the exception public health and philanthropy, these relations were studied less after 1914, precisely when World War II and the Cold War permeated competition between the United States and European countries for Latin America. In the end, these events catalyzed the influence of the United States' techno-scientific penetration in Latin American, encompassed by its political and economic hegemony. While World War II was marked by the struggle between the US and the Axis countries in Latin America through initiatives such as the Office of the Coordinator of Inter-American Affairs, the Cold War could be defined as period of the "US-Americanization of Latin American science and technology." Yet, local scientific communities were not passive actors. They managed to advance their own agendas by "using" the "imperialistic ambitions" of Europeans and US-Americans. In this session, we present a number of case studies focusing on these exchanges through comparative empirical studies of the circulation, translations and re-creations of knowledge and practices in science and technology from the 1930s to the 1950s. The participants of this panel constitute an international research network working on international relations in science and technology and the OIAA after 1940.

Theories of Forecasting

Abstract: During the nineteenth and twentieth centuries, forecasting became a pervasive practice

essential to maintaining the reliable flows of commodities, energy, people and information that are characteristic of industrial societies. Forecasting was also a contested practice that inspired scientific and bureaucratic debates over the accuracy and value of different types of forecasts, as well as epistemological debates over the production of knowledge about the future. This session explores the relationship between ubiquitous and contested forecasting practices and their theoretical frameworks in the contexts of long-range weather and commodity price forecasting, the formation of federal crop insurance in the interwar period, and the roles of bureaucracy and aviation in theoretical debates between competing schools of twentieth-century meteorology. In a paper on the migration of theories of periodicity, Jamie Pietruska examines the popularization of weather and market cycles through the work of commodity price forecaster Samuel Benner and government and private weather forecaster Henry Helm Clayton. In a paper on the U.S. Department of Agriculture's conceptualization of weather hazards and crop insurance, James Bergman focuses on the bureaucratic innovations that put long-range forecasting at the center of agricultural risk management. In a paper on the power of routinized forecasting practice, Roger Turner uncovers the influence of bureaucratic mechanisms as well as aviation in resolving debates within the U.S. Weather Bureau between proponents of synoptic mapping and advocates of geophysical and computational modeling. Taken together, these papers illuminate the routinized technical work of forecasting as both shaping and shaped by theories of predictability.

Toward a Nuanced Understanding of Colonialism and Nationalism: Contestations and Confluences in the Making of Science

Abstract: This panel examines the complex interplay between colonialism, nationalism and science. All the papers represent new and innovative scholarship which raises new questions not only about colonialism, nationalism and science but are linked to broader interpretive themes about the interrelations between history, politics and modern science. All the panelists approach their topics with new methodological tools which gives several new perspectives to the field in general. Khyati Nagar using botanical publications of British scientists in late 18th century India, argues that these publications were envisioned as one of the first progressive steps toward advancing the knowledge of natural history in India. These publications was part of the larger vision of the East India Company to establish a formal network of botanical gardens in its colonies with an agenda of cultivating economically useful plants and for conquering nature. Jason Young demonstrates, through the example of 19th century European national museums, that nationalism and cosmopolitanism are not irreconcilable opposites but instead share intertwined roots in Enlightenment thought. Somaditya Banerjee argues how the Bhadralok (middle-class intelligentsia) science movement, also a nationalist movement, was the root of the new Indian science in the early 20th century, especially in quantum physics. Asif Siddiqi analyses the contradictions in the early phases of the Indian space program in the 1970s, and argues that they provide a striking example of the kind of struggles faced by scientific elites in specifically Indian but also more broadly the post-colonial context during the Cold War.

Towards an Historical Ecology of Research Environments

Abstract: The rediscovery of the laboratory as a major research topic in the history of science in the last decades has shown that laboratory research takes place and is shaped in historically

contingent material, instrumental and spatial settings. Accordingly, the historical reconstruction of these technical conditions has become indispensable to the explanation of the epistemic output of laboratory research. In spite of this revaluation, the task at the end stayed the same: the analysis of laboratory settings is meant to be an explanandum to the knowledge generated by laboratory research. In our panel we would like to reverse this vector of explanation and focus on the laboratory not from the perspective of historical epistemologists but as historical ecologists. Hence, we understand the laboratory not as a mere technical milieu to scientific knowledge production but as a specific habitat of human inquiry more broadly, taking it seriously as an *existentiale* of research. We will argue that a major part of the knowledge produced in these habitats does not fit the distinction epistemic/technical. This is why it remained largely invisible in historiographical analysis. We will shift the focus from epistemic ends to the mundane world of laboratory technologies and knowledges as habitats in their own right. In order to elaborate the historical specificity of this approach, we will revisit the emergence of the research laboratory in 19th and early 20th century, asking for the new 'habitat-knowledge' that constituted and consolidated this modern research environment in glass science, experimental zoology and soil ecology.

Trying Experiences: Empirical Claims, Practical Experiments, and the Authentication of Knowledge in Modern China

Abstract: While China's quest for modernization has often been described in terms of progress and developmental models, it is perhaps better understood as a complex process in which Chinese tried to locate themselves within an unfamiliar global order. As such, the demonstrability and reproducibility of knowledge across contexts was of exceptional importance, and it is impossible to appreciate the significance of science in modern China without taking into account its communicative and coordinative dimensions. Chinese modernity has been marked by a general distrust of knowledge, both local and foreign, and though empiricism, experience, and experiment are more commonly associated with questions of truth value, they were just as often implicated in debates about believability and utility. Could science be relied upon to cross boundaries? Or would it only work where complicated systems were in place to support it? How could Chinese be confident about their new understandings when appearances and well-established systems had failed before? This panel takes a closer look at the ways that Chinese scientists and the Chinese public used shifting notions of fact (*shi*), experience (*jingyan*), and experiment (*shiyan*) to correlate the world they knew with the world they found themselves in and the world they hoped would come. Each of the three papers will present a specific historical case from the late Qing to the People's Republic of China, followed by a commentary that will put the Chinese context in comparative perspective.

Victorian Networks

Abstract: When Samuel Johnson coined the term "clubbability," he considered it an important attribute of an English gentleman; the Parisian Goncourt brothers later mockingly quipped that if two Englishmen were washed up on a desert island, their first act would be to form a club. This session will consider several clubs and informal networks that were important engines of scientific discovery and change in Victorian Britain. Laura J. Snyder will discuss a group of

friends, Charles Babbage, John Herschel, Richard Jones and William Whewell, who formed a Philosophical Breakfast Club at Cambridge University in 1812, describing how, over the next half century, their friendship helped bring about a transformation from the amateur natural philosopher to the professional scientist. Joan Richards will focus on the Astronomical Club, formed in 1820, showing the impact of this network of friends—including John Herschel, Francis Baily, Richard Sheepshanks, G.B Airy, and Augustus De Morgan—on the development of science in the early 19th century. Amy King will explore not only the interpersonal but also the intertextual networks among popular seashore naturalists of the 1850s, including Philip Henry Gosse, W.H. Harvey, Anne Pratt, Margaret Gatty, Isabella Gifford, and J.G. Wood, tracing the relation between natural histories and novelistic realism in the works of authors such as George Eliot. Bernard Lightman will show how the network of future X-Club members who had been together at Queenswood College and then Germany—John Tyndall, Thomas Hirst, and Edward Frankland—had an important impact on the foundation of the agenda for evolutionary naturalism.

Visual Evidence

Abstract: The production and consumption of visual statements have long been central to scientific work. As the recent "visual turn" in the history of science has made clear, scientific visualizations exist in multiple media and serve a wide range of purposes. These include the creation of facts, production of proof, and contestation of competing claims about nature, as well as the capture, stabilization, and transport of observations and phenomena that are too large, fleeting, or mutable to be reliably embodied or shared by other means. This interdisciplinary and comparative session will bring together historians of science and art historians working from the early modern to the contemporary periods to examine related questions connected to the evidentiary functions of visual culture in science and to the ways in which historians can use visual materials as historical sources. The case studies we will discuss are drawn from early modern imperial natural history, nineteenth-century photography, twentieth-century film, and contemporary insect art. Some of the questions we will investigate include: How can visual sources be used as historical evidence? What specialized tools of analysis do we need to bring to the study of visual sources that differ from the ways in which we approach texts? How does medium specificity (drawings, prints, photographs, film, artifacts, assemblages) impact our questions, methods, and answers? We are particularly in visual archives that bring up questions of seriality, collecting, cataloguing, encyclopedism, and juxtaposition.

Paper Abstracts

Alphabetized by Author's Last Name

Globalizing the Public Memory of Mme Curie: Changing Commemorative Practices in the 20th Century

Pnina G. Abir-Am

Abstract: The paper compares the commemorations of Mme Curie and her discoveries of radium and radioactivity throughout the 20th century. The paper seeks to explain patterns of globalization in the public memory of Mme Curie and her discoveries after the end of the Cold War. Though until the 1990s, the commemorations were limited to France and Poland (Mme Curie's adopted and birth countries), the centennial of the discovery of radioactivity in 1998 became a global observance with major events taking place in the U.S. and Japan. The paper concludes with interpretations of the revival of gender stereotypes during the 2011 centennial of Mme Curie's Nobel Prize, shortly after a public debate on the under-representation of women in science in 2005 and since.

Hybrid Habitats in History of Ecology: Winogradsky's Sulphur Bacteria Research, 1880-1900

Lloyd Ackert

Abstract: One of the most interesting questions in the history of ecology is how scientists defined their research environment. Negotiating between the problems and advantages of field and laboratory work, ecologists routinely brought their objects to the laboratory or laboratory methods to the field. This transfer becomes even more ambiguous if ecological research is applied not to plants or animals, but to a new field closely tied to the laboratory – microbiology. In the 1880s the Russian microbiologist Sergei Winogradsky conducted an experimental research program on microorganisms living in extreme habitats – Alpine sulphur springs – which would lead him to propose the 'novel physiological law' of chemosynthesis. Based on his specific habitat knowledges of laboratory and field, Winogradsky deployed a complex array of technologies (microscopes, ehrlenmeyer flasks, and geissler chambers) and practices (from organic chemistry to natural history) to develop a novel 'ecological' research program. This perspective allowed him to generalize his specific conclusions—e.g. that the sulphur granules embedded in Beggiatoa alba filaments were not morphological characters useful for classification, but rather central to the organism's nutritional and respiratory function—into a law of nature. From the perspective of historical ecology, the different environments Winogradsky negotiated come into historiographical focus. Winogradsky juxtaposed his different habitat knowledges to produce a hybrid habitat between laboratory and field, between ecology, microbiology and experimental physiology. By challenging the accepted methods of laboratory research—and their relationship to natural history—in late-19th century microbiology, Winogradsky's hybrid habitat helped to found the new ecological science of soil microbiology.

The Eye and the Telescope: Cartesian Distinct Vision and Teleological Explanation

Marcus P. Adams

Abstract: Descartes notoriously rejects teleological explanations, arguing that searching for final causes in physics is not only "totally useless" (AT VII 55) but also rash since it presumes we are capable of "investigating the impenetrable purposes of God." Descartes argues elsewhere that "it is not the final but the efficient causes of created things that we must inquire into" (AT VIII 15-16). Recent scholarship has refined our understanding of Descartes' rejection of final causes, highlighting Descartes's account in Meditation VI of the "proper purpose of sensory perceptions" as "simply to inform the mind of what is beneficial or harmful for the composite of which the mind is a part" (AT VII 83). In this paper, I draw attention to Descartes's physiology of the eye in the *Dioptrique* (1637) and the posthumously published *Traite de l'homme*. I argue that Descartes appeals to an end to explain the structure of certain parts of the eye—the end of distinct vision. First, I connect Descartes's explanation with Kepler's account of the parts of the eye in *Ad Vitellionem Paralipomena* (1604), arguing that both explain the structure of parts of the eye by appealing to distinct vision. Second, I show how Descartes uses these teleological explanations for two distinct ends: first, they aid in the discovery of efficient causes for his account of the construction of the interior of the telescope in *Dioptrique*, Discourse 9; and second, as the physiological foundation for his teleological explanation of sensations, such as the sensation of color.

Using History to Teach Science: A Career Retrospective.

Garland Allen

Abstract: The history (and philosophy) of science can be of great value in teaching science, both to scientists and to non-scientists, to undergraduate and to graduate students. I have used three avenues in these regards: (1) actual courses in the history of science (e.g., the history of genetics); (2) introduction of historical case studies in biology courses (such as introductory biology); and (3) an historically-based seminar for graduate students in biology, co-taught with a colleague from the Biology Department. Each uses different approaches: focus on secondary or primary literature; the use of case studies or a narrative flow; writing-intensive or not. By examining the actual way research was conducted and teasing apart the thought processes that went into framing research questions or the factors which led to the research in the first place, science students can begin to see the importance of analyzing their own approaches to science and the conceptualization, and even prosecution, of their own projects.

The Colors of Proteins

Nancy Anderson

Abstract: In 1994, GFP, or Green Fluorescent Protein, became the first successful transgenic biomolecular marker when Martin Chalfie inserted the fluorescent substance's genetic sequence, originally found in a jellyfish, into genomes of other species. At the same time biochemist Roger Tsien, with whom Chalfie would share the 2008 Nobel Prize in Chemistry for developing the GFP tool for molecular biology, was busy producing a variety of GFP colors by forced mutations of the sequence. Tsien, however, not only created a glowing palette from the GFP sequence, he

paired his new colors to create what he called cameleons, a way to color-code calcium levels in living cells. Cameleons entail a tandem combination of two GFP variants, whereby one wavelength is emitted by the first variant, which then excites the second variant to emit color of another wavelength, and thus the same protein can change color like a chameleon. The phenomenon exploited is known as fluorescent resonance energy transfer, or FRET. In this paper, then, I will consider color as a physical event. To do this, I will turn to the philosopher of science Gaston Bachelard, who analyzed color as phenomenon and phenomenotechinique as well as a matter of both reality and rationality. Following Bachelard's understanding of color, Tsien's GFP "paintbox" (his description) and cameleon research will be addressed as both "subjective" aesthetic encounters and as cases showing color as a manipulable "objective" reality communicable and subject to rational control (Bachelard, *Matérialisme rationnel*).

Mapping Madagascar: Maps as Visual Interpretations

Thomas Anderson

Abstract: Maps are a crucial part of discovery and exploration, charting routes alongside topographical features such as mountains and rivers. Maps were used during the nineteenth century as part of the scientific process because of their ability to record in visual format vast amounts of empirical data and observations, yet they also reveal the viewpoints of their creators. On Madagascar, the fourth largest island in the world, with an ecosystem where over 80% of its species are endemic, maps were an integral part of how Westerners perceived and understood the island. Madagascar's size, biodiversity, and multiple climates and terrains challenged Western naturalists' attempts to explain the origins of the island's natural history, even as Madagascar established a reputation as a peculiar world. Further, information regarding the island often remained incomplete and sparse during the nineteenth century. But by rearranging and distilling empirical data, maps erased fantasies and inaccuracies about Madagascar by translating the latest science into an image that provided a comprehensive understanding of the island that often exceeded specific knowledge. Maps were used alongside publications not just to support, but also to frame the scientific message as well as popular perceptions about the island. By offering a visual summary, maps offered the appearance of objectivity in an easy-to-understand format. This paper explores how maps offer a way to understand how Westerners conceptualized not only Madagascar's natural history, but also its potential as a site of Western control.

The Oceanic Feeling in Human Biology: The Voyage of the Zaca, 1934-35

Warwick Anderson

Abstract: In 1929 and 1934-35, the physical anthropologist Harry L. Shapiro voyaged in the South Seas on the Mahina-I-Te-Pua and the Zaca, measuring mixed-race islanders, including the descendants of the Bounty mutineers on Pitcairn Island. His research in Polynesian hybridity reflects the growing cultural and scientific investment of the United States in the Pacific during this period. Shapiro's oceanic adventures and intimate encounters prompted him to discount typological speculation and emphasize instead the liberal Boasian program in physical anthropology, giving him the confidence to refigure his evaluations of racial difference. The

seaborne investigatory enterprise came to influence U.S. racial thought, adding impetus to the condemnation of racism in science.

Why Do Australians Eat What They Do for Tea?: Toward a History of Ethical Food Choices

Rachel A. Ankeny

Abstract: There is increasing awareness that our choices about what foodstuffs to consume are more complex than a simple response to an empty stomach. We are variously encouraged to eat local, organic, or sustainable foodstuffs; to consider whether our foods have been produced in humane or sustainable ways; or more generally, to buy and eat responsibly. We are encouraged to make food choices which are 'ethical,' yet even people attempting to eat ethically feel that they have inadequate scientific, nutritional, and other information about the products that are available. An ongoing project seeks to understand these key questions associated with food ethics in contemporary Australia, including the intersection between people's understandings of the science behind key food categories (such as genetically-modified or organic foodstuffs) and their food habits and choices. In addition, this project aims to establish an account of how these understandings came to be formed in modern-day Australia, against the backdrop of broader sociocultural and other factors which have shaped this nation. This paper examines the use of methods in the social sciences, notably surveys and focus groups, to explore this contemporary and recent food history. It shows how such methods can be used to explore not only individuals' opinions and views, but to elicit broader sociocultural trends which in turn can serve as the basis for developing a longer-range historical narrative about ethical eating in Australia.

Habitats of Organized Science: Louis Guttman and the Israel Institute of Applied Social Research

Tal Arbel

Abstract: My paper will examine transnational patterns of knowledge migration in the postwar period, focusing on the successful indigenization in Israel/Palestine of the 'American model of social science' from the mid-1940s through the late 1960s. As I will argue, this transplantation project, itself an early example of the traveling of facts to the decolonizing world, contributed in turn to the stabilization of knowledge claims and overall credibility of academic institutions that emerged from the war as global centers of social-behavioral science research and innovation – primarily American research universities. Although the "Americanization of social science" has become a historiographic token among historians of social science, existing studies on the whole have stopped short of inquiring into the actual processes of knowledge migration in the postwar period. My paper will aim to address this methodological lacuna by grounding and concretizing the intertwined processes of standardization, internationalization, and "Americanization" in the movements and everyday practices of individual scientists. This historiographic framework will be put to the test with the case study of Jewish-American sociologist and statistician Louis Guttman, who was among the architects of The American Soldier, an expert on psychological measurement and a pioneer in the application of cutting-edge behavioral science to the making of a new state. Tracing Guttman's career trajectory, scientific collaborations and entrepreneurial

efforts at institutionalizing survey research in Israel, I will inquire into the "scientific life" of this new, culturally-versatile and highly mobile scientific type.

Poincaré and the Extension of the Mathematical Tools of Celestial Mechanics

Tom Archibald

Abstract: Poincaré greatly extended the mathematical tools of celestial mechanics, both in his research papers and in his lectures at the Sorbonne. The tools themselves were in some cases his own highly original creation (as with the qualitative theory of differential equations and its application to stability of orbits) while in others they brought into play older theories that had not been incorporated into the working practices of theoretical astronomers. His uses of Hamilton-Jacobi theory, and Hamiltonian mechanics generally, are an example of the latter. First outlined extensively in his *Méthodes nouvelles de la mécanique céleste* of 1892-93, a work of notorious difficulty, Poincaré also used the Hamiltonian approach as the starting point of his Sorbonne lectures on the subject from 1905 onward. This subject has been approached in the historical literature many times, largely in attempts to understand the development of this work in the context of Poincaré's own practice, notably on issues concerning the three-body problem. In this paper I examine the reception of aspects of these methods in the community of practitioners, both in the period when they were first introduced and following the lecture course. Poincaré was keenly aware of the necessity of addressing different publics: mathematicians, astronomers, physicists, students, and even a broader learned public. We examine the obstacles facing the general adoption of Poincaré's methods, as well as the interest they produced in various circles in France and elsewhere.

The Only Options?: "Experience" and "Theory" in Debates over Forensic Knowledge and Expertise in Early Twentieth-Century China

Daniel Asen

Abstract: During the last years of the Qing dynasty and throughout the Republican period, expertise grounded in the epistemic authority of science became compelling if not indispensible for many areas of economy, governance, and everyday life. In the forensic investigation of suspicious deaths, legal officials, coroners, forensic scientists, and urban publics debated the role that science and scientists would play in modernizing China's late imperial tradition of forensics. Yet, despite the sophistication of this long-standing tradition, these debates took place almost exclusively within the conceptual parameters of modern science and its theorizations of knowledge. Forensic scientists argued that their expertise, grounded in scientific theories (*xueli*) of anatomy, pathology, and chemistry, was more certain than were coroners' merely empirical insights. As coroners asserted that late imperial forensics could hold its own against the epistemic challenges of reformers, they embraced experience (*jingyan*) and its positive associations with the empirical approaches to knowledge and experimentation (*shiyan*) on which the causal explanations of science depended. In doing so, they used this modern discourse of knowledge to reclaim older conceptions of experiential knowledge and skill that had been long valorized in late imperial forensic practice and scholarship. By untangling these disparate claims over the "empirical," this paper explores the ways that the increasingly limited and hegemonic

epistemic vocabulary of modern professionalization shaped the possibilities and politics of expertise and science in early twentieth-century China.

A Bridge over Troubled Water: Max Planck's Use of Abstract Spaces

Massimiliano Badino

Abstract: Analyzing one episode in the history of twentieth-century physics, I will underline the capability of formal representations to be a powerful support for knowledge production and for the transfer of conceptual resources between different areas of knowledge. The episode I will focus upon is the emergence of Planck's quantum theory of monoatomic gas between 1915 and 1921. As early as 1906, Planck introduced a new technique to quantize a mechanical system. His procedure, based on a special partition of an abstract space used in statistical mechanics, allowed him the formal machinery developed for a gas to extend to the treatment of an oscillator. After 1911, in his attempts to build up a quantum theory of gas, Planck applied this technique again, in the opposite direction: the abstract space worked as a platform to transport the quantum from the oscillator to the gas. The story is not straightforward, however, since in developing the project of a quantum theory of gas, Planck was pursuing the more ambitious program of establishing an absolute concept of entropy, a dream that had obsessed him from the beginning of his scientific career. I will show that this project changed substantially his use of the formal representation of a quantum system and eventually led his theory astray. It was left to Einstein in 1924 to retrieve the function of the abstract space as a vector of conceptual resources and to formulate the first satisfactory quantum theory of gas.

“Keeping in the Race”: Ernest Rutherford, Scientific Internationalism, and Nature, 1895-1914

Melinda Baldwin

Abstract: By the end of the nineteenth century, the British scientific magazine *Nature* had established a stable base of readers and contributors in Great Britain and was one of the most important publications in British science. It was not, however, a publication with much international influence. This paper explores the publishing strategies of the physicist Ernest Rutherford and argues that Rutherford’s frequent Letters to the Editor in *Nature* established a new strategy for contributions to this weekly journal. After accepting a post at McGill College in Montréal, Rutherford was extremely concerned about establishing priority for his work, and took advantage of *Nature*’s weekly publication schedule in order to quickly share experimental results he felt might be important. Rutherford’s participation in the journal influenced his students and colleagues in the field of radioactivity physics, and drew physicists like the German Otto Hahn and the American Bertram Borden Boltwood to submit their work to *Nature* as well. *Nature* came to play a major role in spreading news of the latest research in the science of radioactivity. However, despite the growth in international contributions from physicists in the years leading up to World War I, *Nature* remained firmly grounded in its British roots. Other growing disciplines, such as genetics, did not attract nearly as many non-British contributors as radioactivity, and the journal remained focused on science and scientific issues in Great Britain.

Performing Science, Producing Nation: The Construction of Bhadralok Physics in Early 20th-Century Colonial India

Somaditya Banerjee

Abstract: When crucial discoveries about quantum mechanics and astrophysics occurred in the 1920s, not many scientists in India read the news, understood the nuts and bolts of the physics, realized its implications and participated in the process. Meghnad Saha, Satyendranath Bose and Chandrasekhara Venkata Raman, were the first generation of indigenous Indian physicists who read, understood and contributed in arguably the most revolutionary decade of discovery in the history of physics. The Indian scientists belonging to the category of *Bhadralok* (middle-class intelligentsia) were mostly known in the West through their publications, with little understanding about the conditions of their work and how they managed to develop an innovative research program in quantum physics under colonial rule. Being scientists from a colony, it is surprising how they accomplished such a feat. This paper seeks to examine the images and practices of science in colonial India in the early 20th century by looking at some of the first generation of indigenous scientists trained in India. I will argue that the Bhadralok scientists were the roots of the new Indian science, especially in quantum physics. The Bhadraloks were also part of the wider Indian nationalist movement and considered their scientific advances as a conceptual tool of Indian nationalism. The defining feature of the Bhadralok movement was the fusion of modernity with tradition in the route to the formation of the Indian nation-state.

Cosmopolitanism, Patriotism, and the Limits of Religious Toleration in the Italo-Swiss Republic of Letters

Lydia Barnett

Abstract: In the early decades of the eighteenth century, letters, specimens, and scientific ideas began to flood through the narrow mountain passes which connected Switzerland and northern Italy. Even as savants on either side of the Alps eagerly reached out to one another for the sake of philosophical exchange, their commitment to international science was tempered by the religious commitments which still held sway in the land of Calvin and in the seat of the Roman Catholic Church. The possibility of finding neutral common ground was complicated by the fact that so many philosophical questions touched on theological issues, and by the desire of many Protestant savants to have their philosophical studies serve apologetic ends which their Catholic counterparts would never accept. This paper takes as a case study the extensive correspondence and friendship between the Swiss Huguenot naturalist Louis Bourguet and the Italian naturalist Antonio Vallisneri. Their two main topics of conversation – generation and the history of the earth – were hot-button issues which constantly set off flares of dissension. Their philosophical discussions required constant vigilance in censoring both themselves and each other for the sake of having the conversation continue. By discussing the various strategies by which these two savants were able to maintain a friendship and a correspondence over the course of two decades, the paper seeks to understand the actual practices, rather than the oft-discussed ideals, of toleration and cosmopolitanism at the dawn of Enlightenment.

Panel with Marcia Bartusiak, Executive Director, Graduate Program in Science Writing, Massachusetts Institute of Technology

Marcia Bartusiak

Abstract: Combining her training as a journalist with a graduate degree in physics, Marcia Bartusiak has been covering the fields of astronomy and physics for more than three decades and has published in a variety of publications, including Science, Smithsonian, Discover, National Geographic, and Astronomy. Her latest book is *The Day We Found the Universe*, about the birth of modern cosmology in the 1920s, which was reviewed by the San Francisco Chronicle as "a small wonder" and received the History of Science Society's 2010 Davis Prize for best history of science book for the public. Bartusiak has also written *Thursday's Universe*, a guide to the frontiers of astrophysics; *Through a Universe Darkly*, a history of astronomers' quest to discover the universe's composition; and *Einstein's Unfinished Symphony*, a chronicle of the international attempt to detect cosmic gravity waves. Each was named a notable book by the New York Times. Another of her books, *Archives of the Universe*, a history of the major discoveries in astronomy told through 100 of the original scientific publications, is used in introductory astronomy courses across the nation. In 2006 Bartusiak received the prestigious Gemant Award from the American Institute of Physics for her significant contributions to the cultural, artistic, and humanistic dimension of physics and in 2008 was elected a Fellow of the American Association for the Advancement of Science for "exceptionally clear communication of the rich history, the intricate nature, and the modern practice of astronomy to the public at large."

Things That Channel: Subject Lessons from Religion, Spirituality and Psychology

Betty M. Bayer

Abstract: What subject lessons emerge by reconsidering histories of "the spiritual" beyond treatments of "the spiritual" as antithesis to the rational, a line of argument assuming spirituality's self-evident nature as quackery or madness, end of story? What happens by revisiting "the spiritual" beyond the history of science's practices of debunking psychology or religion? To inquire into this history is to confront "things that channel" writ large. To channel is to serve as a medium; to be a channel is to connect things, such as earth and water, mind and matter, exterior and interior life. The noun 'subject' is also a term of location, position and things-in-relation. One becomes subject to an order of life, be it religious or psychological. 'Subject' indicates the senses, the material out of which things are made or the substance in which attributes inhere. As guideposts, these intertwined meanings reframe the historical conundrum reiterated in histories of mediums, spirituality and religious experience in debates amongst science, religion and psychology on the brain, mind, matter and experience. This paper thus draws on a nineteenth and mid-twentieth century study of "the spiritual," cases repeatedly drawn on, to ask: of what else is "the spiritual" a channel? How does "the spiritual" reveal the intertwining of religion, science and psychology in imagining the operations of the mind anew? How were disciplinary lines redrawn by turns in spiritual study? What practices of science or of religion emerged from debate on "the spiritual"?

Resolving the Puzzle of the Construction of the Heavens: The Role of Celestial Spectroscopy

Barbara J. Becker

Abstract: To solve the puzzle of the true construction of the heavens, William Herschel established a programme of celestial observation and classification that was avidly pursued throughout the nineteenth century. All the best puzzles, like earthquake-prone landscapes, nurture a stealthy yet steady buildup of fertile tension beneath their seemingly tranquil surfaces. Herschel's celestial puzzle was no different. Observers who tackled the challenge expected the solution to emerge in consequence of imaginable improvements to methods and instruments with which they were familiar, namely expert use of a fine telescope. Some named new objects or classes of objects to study; others improved existing instruments. The most provocative suggested new questions or asked old questions in new ways. But none triggered the seismic shift in thinking about the construction of the heavens needed to transform the puzzle's terrain. I will show that ground-breaking advances did not come until after the introduction of spectrum analysis into astronomical work. In particular, the bold decision of English amateur astronomer William Huggins (1824-910) to examine the spectra of nebulae and his intrepid use of spectroscopy to measure stellar radial velocity irreversibly altered the landscape of astronomical practice and gave those hoping to resolve the question of the construction of the heavens a new and more productive perspective on the puzzle.

Using Pictures in the Late Nineteenth Century Scientific Periodical Press

Geoff Belknap

Abstract: This paper addresses questions over the use and construction of images in the scientific periodical press in the 1870s. How were images used to construct a specific editorial visual epistemology? In what ways does the process of image construction affect the information being displayed, and where does editorial control come in? Through an examination of two competing illustrated scientific periodicals, *Nature* and *Knowledg*e, this paper will aim to address the ways in which scientific controversies were informed by, and at times constructed around, the use of images. The key to understanding this will be an analysis of the broader influences on the visual content in *Nature* and *Knowledge* and how the competition between the two editors of the competing periodicals, Norman Lockyer and Richard Anthony Proctor, developed their own visual style, and how this style reflected the content, audience and construction of the periodical as a whole. Finally, this paper will also address the ways in which technologies used to produce images in *Nature* and *Knowledge*, in particular photography, affected the construction of scientific authenticity within the periodicals. The influence of this particular form of technological visual epistemology will be informed by both a close analysis of images within the two periodicals themselves, as well as a discussion of the ways in which non-visual arguments constructed a value of photography and the various other modes of image production that the scientific periodical press utilized.

Underwriting the Atmosphere: Meteorology, Economics, and the Development of the Federal Crop Insurance Corporation

James Bergman

Abstract: The paper will focus on the conceptualization of weather hazards and crop insurance in the Department of Agriculture in the interwar period. It will do so by tracing two developments of the period. The first was an intense discussion of the appropriate mechanism, and institution, with which to stabilize the income of farmers over time and space, a discussion that culminated in the development of a Federal Crop Insurance Corporation in 1938 that stabilized the farmer's income for any hazard beyond the farmer's control. The latter was the significant growth of the department's bureaucracy for information acquisition and forecasting and the increasing presence of economists in areas previously controlled by natural scientists. The integration of multiple risks, each entailing different disciplinary techniques for their assessment, facilitated a restructuring of agricultural risk management from one based on either local cooperatives or smaller private insurers to one based on intense federal involvement over wide territories.

Beyond the "Book" of Nature: Putting Pictures in their Place in Systems of Visual Displays of Anatomy

Carin Berkowitz

Abstract: Late eighteenth- and early nineteenth- century anatomy depended upon a variety of visual displays. Drawings in books, particularly the beautiful and elaborately illustrated books that have been the objects of historians' fascination, were limited in their circulation. These illustrations were understood to function alongside chalk drawings done in classrooms, casual and formalized experience with animal and human corpses, text describing or contextualizing the images, and preserved specimens. This system of visual displays was used both in the development of new knowledge and in the teaching and conveying of established knowledge. Historians have attempted to understand the relationships between representations and knowledge, between seeing and knowing, by extracting books from that system of visual displays, looking at images and illustrations in isolation as objects of study representative of classes of things. In so doing, they have granted a primacy to elegant and beautiful books of the sort that are recognizable as the medium for knowledge to our modern eyes, but that attribution risks denying the significance of a context of use during the period. I argue here that the constellation of visual displays used by anatomists defies categorization into the neat and naturalized dichotomies of nature (or object) and representation and image-as-representation and text-as-knowledge (or -as-argument), dichotomies that are themselves modern; and that drawings cannot be removed from the spectrum of visual displays without fundamentally misunderstanding their use.

The Chymical Cleric: Science, Theology and the Professional Life of John Allin in England and America (1623-1683)

Donna Bilak

Abstract: This paper explores the professional world of the Puritan alchemist John Allin (1623-

1683), seen through the lens of his social networks and intellectual pursuits, and examines Allin's place and participation within the emerging empirical sciences. Focus centers on intersections between Allin's scientific practice and religious beliefs in relation to socio-cultural environs in England and colonial America that shaped his intellectual template and informed his moral compass. Viewed in retrospect, Allin's life reflects both the socio-political fluidity and intellectual vibrance that characterizes 17th-century Anglo-American history. The son of a religious dissenter and New World emigrant, Allin was prepared for a professional career in divinity, law, and physic at Harvard – the Massachusetts Bay Colony also being where Allin was introduced to the millenarian and alchemical ideas that fed into his religious, political and scientific views as an adult. Returning to Cromwellian England, Allin became minister of the gospel in Rye until his ejection under the 1662 Act of Uniformity, thereafter supporting himself and his family as a dissenting minister, solicitor, unlicensed medical doctor, and alchemist in Restoration London. But in 1680, Allin went back to America as minister-physician to the town of Woodbridge, New Jersey where he died three years later. Through consideration of the scope and trajectory of Allin's career, this study illuminates the workings of the dynamic social system to which Allin belonged that orbited around medico-scientific ideas, practices, and commodity exchanges on both sides of the Atlantic.

The Imperial Visual Archive: Science and Visual Evidence in the Early Modern Hispanic World

Daniela Bleichmar

Abstract: The imperial archives of the early modern Hispanic world (ca. 1492–1820) are replete with visual evidence, particularly when it comes to the production and circulation of scientific information. Early chroniclers presented visual materials and pictorial language as the best-suited means of discussing the natural world of the Americas. Imperial and colonial administrators, travelers, and settlers in the New World repeatedly commissioned pictorial sources, often from indigenous hands. The importance of visual evidence within this empire became so thoroughly established that from early on colonial subjects with a point to argue, a claim to prove, or a favor to request resorted to pictorial means. And yet the contents and implications of this visual archive over the imperial longue durée remain underexamined. My paper will provide a panorama of the Hispanic imperial visual archive, examine connections between scientific visualizations and visual evidence in other often related contexts (religious, administrative, legal, commercial), analyze the particular uses of images in local and trans-regional settings, and address some of the challenges that these pictorial sources pose in terms of their colonial manufacture. Beyond the specificity of this historical case study, the paper seeks to foster methodological and theoretical conversations with historians of science and visual culture working on related issues in other places and periods.

Kepler and the Cometary Spirit of 1607: Religion and Science in Early Modern Society

Patrick Boner

Abstract: In the winter of 1608, Kepler received a cold response from the University of Leipzig. Kepler had sent his complete account of the comet of 1607 there only to provoke the censure of the theological faculty. If Kepler did not reconsider his theory of cometary spirits, he was told,

his manuscript would not be published. That Kepler complied with this request, I argue, did not eclipse his greater goal of refining a theological view through his insight as a natural philosopher. As his exchange with the theological faculty reveals, Kepler sharpened his sense of Sacred Scripture in concert with his new and causal account of nature. The controversy that Kepler roused by his claim sheds new light on the disciplinary landscape of the early modern university and the lines that Kepler crossed in his cometary theory. It also elucidates the dynamic nature of science and religion and their close entanglement in the eyes of Kepler and many of his intellectual contemporaries.

Teaching History and Science and the History of Science in the Field and the Lab

Mark E. Borrello

Abstract: Teaching and research collaborations with scientists present historians with excellent opportunities to expand their intellectual and pedagogical range. In this presentation I would like to discuss how my experience of co-teaching a field course in Tropical Ecology and Conservation in Panama and my current collaboration on the evolution of multi-cellularity have positively impacted students at both the undergraduate and graduate level.

The Planetary Extension for the Antikythera Mechanism: Statistics, Analysis and Reconstruction

Niels Bos

Abstract: The Antikythera mechanism is one of the most extraordinary examples of ancient Greek technological development and expertise. This amazing piece of geared technology could best be described as a complex mechanical computer from the second century B.C., which tracks and predicts various cycles for – and related to – the Sun and the Moon. Due to its extraordinary design and complexity the Antikythera mechanism is truly unique; no other geared devices with similar technological architecture are known until the late Middle Ages. Within the surviving fragments of the mechanism are remains of multiple sets of dials and pointers able to represent time according to different calendars and show the positions of the Sun and Moon along the zodiac. One of the many intriguing questions surrounding the mechanism is whether the movements of the planets were also described by the device. Various indications have been found supporting the existence of some sort of planetary representation. However, no actual evidence of this has been found in the surviving fragments of the Antikythera mechanism. In this presentation I will discuss an analysis and statistical study of possible options for a planetary extension. I argue for a gear work design with a modular composition to represent the locations of the planets along the zodiac and I present a framework of boundary conditions to restrict the number of gear train reconstructions. By using 3D CAD-modeling software I am able to make reconstructions of the Antikythera mechanism, including a planetary extension.

Descartes as Hands-On Practitioner

Jenny Boulboullé

Abstract: In popular reception the French philosopher René Descartes has been identified with

his famous 'cogito', creating an image of a thinker with no hands who explored the possibilities of knowledge with his *ratio* alone. In this paper I want to explore Descartes' thoughts on what knowledge is and how it can be obtained from a different perspective. What if we envision Descartes as a researcher who has first and foremost explored the world from a hands-on perspective? Recent studies have convincingly argued that Descartes has been an experimenter who was actively involved in the sciences of his day, demonstrating that he stood at the cradle of what has become known as the 'new science'. I discuss in this paper recent philosophical and historical studies that re-contextualise his metaphysical works historically and that situate these works within his extensive 'scientific' writings or better experimental natural philosophical inquiries. This paper expands on the attempt in recent scholarship to regain a perspective on the practicing philosopher of flesh and blood. Instead of confining his epistemological considerations to the bloodless realm of pure reason, I will argue that we should examine Descartes' epistemological writings for reflections on new kinds of hands-on engagements and experiences that emerged with the rise of experiment as a new methodological device for natural philosophical inquiries in 17th-century Europe. I will link this exploration to an actual debate over the need to theorize the role of hands/hands-on work in the production of scientific knowledge.

The Toughest Diagnosis: Debating the Supernatural in the Republic of Letters, 1650-1750

Brad Bouley

Abstract: In 1727 Antonio Vallisnieri dissected the body of Gregory Barbarigo as part of the cardinal's canonization proceeding. When testifying about the corpse before canonization officials, Vallisnieri walked a careful doctrinal line claiming that the cadaver's incorruption was "wondrous but not miraculous." It was only in a letter to his friend, Ludovico Muratori, that Vallisnieri unabashedly asserted that nothing even close to a miracle had occurred. In fact, he told Muratori that by purporting that something special was going on, the Church was giving ammunition to those who wished to attack it. Catholic physicians at the end of the seventeenth century were in a tough position: they were required to verify miraculous healings and uncorrupted bodies by the Church. However, many physicians had developed standards about the boundaries of the natural and what counted as holy, which differed from those of the Church. After all, in another letter, Vallisnieri stated that Saint Francis de Sales's great claim to sanctity was not his litany of miracles, but the charity he showed in donating his body for a public anatomy. Through looking at Vallisnieri's correspondence, along with that of Giovanni Maria Lancisi, Giovan Battista Morgagni, and Marcello Malpighi, this paper will reconstruct where these great physicians thought the bounds of the natural lay. In doing so, I hope to paint the thinkers as part of a Catholic Enlightenment—one that is not wholly secular, but also not blindly willing to believe.

Expanding Medical Horizons or Dancing With a Dream?: Science and the Recent History of Alternative Medicine

Eric W. Boyle

Abstract: As a systematic body of knowledge or practice, science has been a malleable tool in the history of alternative medicine. Advocates of alternative medicine have alternately dismissed

and embraced the methodological and theoretical bases for scientific inquiry and analysis, while skeptics have employed their own scientific measurements and arguments to question therapeutic claims and challenge the methods and principles of alternative approaches to research and practice. This paper examines the use of different forms of scientific argumentation and evidence in the recent history of conventional and alternative medicine (CAM), with particular focus on debates surrounding the creation of the Office of Alternative Medicine (OAM) at the National Institutes of Health in 1992 and the National Center for Complementary and Alternative Medicine (NCCAM) in 1999. Congress established these institutions primarily to study unconventional therapies and disseminate information to the public, but the effort to meet such a mandate generated a tremendous amount of controversy. While OAM and NCCAM leadership have vowed to apply existing, rigorous scientific standards to the study of CAM, thereby expanding the horizons of health care and biomedical science, CAM advocates have questioned whether science is applicable and critics have likened CAM research to dancing with a dream. These competing arguments can be explained partly by the economic and professional interests involved in efforts to validate or invalidate unconventional therapies, but the recent history of CAM at NIH also indicates that the relationships between politics, science, and medicine are shaped by transcendent ideologies.

The Area Should Be Treated as a Laboratory: Scientists, Controversy, and the Vietnam War

Sarah Bridger

Abstract: The botanist and bioethicist Arthur Galston once reflected that with the use of defoliants in Vietnam, the botanist, probably the last of the scientific innocents, was unexpectedly catapulted into the same ethical hot pot as other scientific colleagues. Although little of the technology and weaponry employed in Vietnam drew on new scientific discoveries, the war was nevertheless a turning point both for popular views of science and for scientists views of the value and morality of government and military work. This paper examines the contributions of a range of scientists, including physicists, chemists, and biologists, to the war effort, and the political controversies sparked by their work. Key examples include the development and use of chemical defoliants and tear gases, the construction of the electronic barrier across the Ho Chi Minh trails, and the influence of high level military science advisors.

On Microscopic Hearing: Fairy Magic, Musical Science, and the Technologies of the Nineteenth-Century Orchestra

Francesca Brittan

Abstract: The vogue for microscopy that gathered impetus through the early decades of the nineteenth century revealed a hidden and robustly populated miniature world. This world was connected to the advancement of science as well as the restoration of lost magic; the new entomological kingdoms it magnified were also described, in scientific and fictional writing, as fairylands, just as insects themselves were figured as interchangeable with fairies. New visual technologies (new ways of seeing) were directly responsible, as this paper argues, for new aural technologies (new modes of hearing). In the musical world, microscopes were compared to novel orchestral instruments and, more often, to the modern orchestra itself. Both Mendelssohn's and Berlioz's well-known fairy pieces called on new kinds of musical textures and timbres—new

compositional technologies—to amplify the miniature natural world and, in doing so, reveal a supernatural landscape hidden within. Reviewers heard in their elfin soundscapes both poetic "expression" and mere "imitation," both fairy song and insect sound. The orchestra itself, they claimed, had become a scientific as much as a poetic instrument, a magnifier of the 'real' world as well as a conjurer of the imaginary one. This overlapping of fantasy and technology explains some of the long-standing mysteries surrounding the origins and models of nineteenth-century fairy music. More broadly, it invites us to consider the ways in which microscopic realism and miniaturist idealism interacted in both the aesthetic and scientific realms through the middle decades of the century.

The Scientific Survey of Puerto Rico: Intersections of Metropolitan Science and American Empire

Darryl E. Brock

Abstract: Theodore Roosevelt, in 1905, called for a major scientific survey of the nation's new tropical colonies. The National Academy of Sciences met the president's challenge, imagining a visionary survey of the zoology, anthropology, botany, forestry and geology of the Philippine islands, a breathtaking program that would never come to pass. If government would not embrace the charge, private institutions would step into the breach, but in a different theater. The Pacific call to action instead had laid out the road map for the Caribbean. The New York Academy of Sciences, in close concert with the city's American Museum of Natural History, and also the Botanical Garden, adopted a plan in 1912 that closely mirrored the NAS plan. Their "Scientific Survey of Porto Rico and the Virgin Islands" represented not just colonial science, but a metropolitan science that would conquer the new scientific frontier of Puerto Rico. Swarms of expeditionary scientists would catalog the plants, animals, geology and archeology of Puerto Rico, bringing samples for display to museums throughout the New York City area, tangibly demonstrating America's far-flung imperium and power to a curious populace—a metropolitan populace. The people could vicariously embrace the new American empire; the city could demonstrate its civic worth with comprehensive scientific catalogues. Orchestrated by the city's scientific elite, it would be funded by the Wall Street elite, the Carnegies, the Rockefellers, and the Vanderbilts. Envisioned as a five year project, the Survey expeditions would actually continue until 1933, with the Academy's scientific results ultimately comprising nineteen volumes.

Reconstructing Applied Science and the "Representative Anecdote" in 1870s Britain

Robert Bud

Abstract: The paper will look at the way the emerging interpretation of applied science in its formative years of the 1870s was constituted by iconic stories told about it. I will link a novel theoretical treatment drawing on Kenneth Burke's concept of the "representative anecdote" with quite new empirical work on the politics, journalism and ideology underlying the foundation of schools of applied science during the 1870s. The potential theoretical contribution of Kenneth Burke's 1945 Grammar of Motives will be explored here. The idea of the representative anecdote has long been familiar to literary critics and in recent years has been used by communications scholars looking at vernacular concepts of medicine and the environment but

not yet by historians of science in the public sphere. Two case studies will be examined: the founding the Yorkshire College of Science and of Mason College of Science (later Leeds and Birmingham Universities), 1869-1880. It is the discourse of applied science in the fine grain of these institutional processes that is of interest here. In both Birmingham and Leeds one sees the deployment of stories of 'applied science' (James Watt and Robert Stephenson respectively) by promoters of new institutions working closely with newspaper editors closely associated with the new Liberal party. These 'anecdotes' of their careers became themselves iconic as they sustained particular institutional forms and the cultural category of 'applied science'. This British story will be linked to the contemporary US development of the Case School of Applied Science in Cleveland, endowed in 1877.

From Invention to Experiment: The Privilege System as a Model for Scientific Knowledge Production

Marius Buning

Abstract: This paper shall deal with privileges for inventions in the early modern period. These pre-modern "patents" were omnipresent and highly influential throughout Europe, yet they have been relatively neglected in the study of the history of science. This paper shall primarily focus on privilege practices in the Dutch Republic (1585-1625). After presenting some newly found material and giving a brief outline of the workings of early modern privilege law, the paper shall contend that privilege practices created a space where experimental science and mathematical reasoning could interact. Thus the privilege system – in essence a legal tool applied to economic needs – played a crucial role in the development of a modern attitude towards the verification of knowledge.

Techniques of Excavation, Seriation and Stratigraphy in the Establishment of "Woodland Period" and "Late Prehistoric Period" Chronologies in Late-Nineteenth and Early-Twentieth Century American Archaeology

Conor Burns

Abstract: This paper will survey episodes in the establishment of "Woodland period" and "Late Prehistoric Period" chronologies in late nineteenth and early twentieth century American archaeology. These labels now apply broadly to a myriad of overlapping ancient human populations once extant throughout the eastern and central western portions of the continent from around 1000 BC to ca. 1650 AD. The emergence of scientific archaeology in the nineteenth and early twentieth century is often associated with steady improvements in excavation techniques, in serial interpretations of stone tools and pottery styles, and in increasingly refined attention to stratigraphic context. To what extent these developments played out in the establishment of "type sites" used to determine chronologies will be the main focus of this paper. Particular focus will be devoted to the work of Warren King Moorehead, who worked extensively at the Fort Ancient and Cahokia sites in the late nineteenth and early twentieth century.

Helmholtz and Heidelberg's Fame

David Cahan

Abstract: This presentation argues that the nature of Hermann Helmholtz's research and public lecturing contributed substantially to Heidelberg's development and image as a major science center. During the late 1850s and 1860s he worked in both physiology and physics, not to mention the study of human vision and the development of non-Euclidean geometry. Moreover, he helped popularize science and discussed its relationships with economic development and culture through his lectures of 1861 and 1864 on the conservation of energy before the Royal Institution in London; his pro-rectoral address of 1862 on the relations of the sciences and of science and the modern nation-state; his semi-popular book, *On the Sensations of Tone* (1863); the first appearance of his *Popular Scientific Lectures* (1865); and his public lecture (1869) on the aim and progress of natural science. Finally, his own enormous professional success was due, it is further argued, in part to Heidelberg's institutional structure—including the close personal friendships that he made with the chemist Robert Bunsen and the physicist Gustav Kirchhoff—and to the town itself. In short, the presentation argues that when Helmholtz arrived in Heidelberg in 1858, the university had just emerged from its long institutional stasis as a provincial institution; that during the next thirteen years, until he left for Berlin in 1871, it enjoyed its period of greatest fame; and that thereafter it entered into institutional decline. Like no other single individual, Helmholtz brought attention to the University of Heidelberg, and when he left, a good deal of that attention left with him.

"Sharpen Your Pencil, Send in Your Order": Modern Amateur Telescope Making's Mail Order Base

Gary Cameron

Abstract: Amateur telescope making became a popular hobby in America from the 1920s onward. Sparked by a series of articles in Scientific American, thousands of dedicated amateur telescope makers ('ATMs') all over the country began working away in basements, garages, and even kitchens, making telescopes at home. Although many enterprising individuals managed to scrounge materials locally, the vast majority depended on mail-order companies that offered telescope making supplies (glass discs, abrasives, and polishing compounds) and key components (eyepiece lenses, gears, motors, and other mechanical parts). There were few companies dedicated to serving ATMs in the United States prior to 1940. However, the Post-War period saw an explosion in the numbers of such firms, many of them benefiting from the ready availability of military surplus optics from 1945 onwards. Companies like A. Jaegers (aka, "The Glass House"), Edmund Salvage (later, Edmund Scientific), and many others, established a firm base of loyal customers by supplying a wide variety of products at reasonable prices with quick delivery times. Many of the founders of these companies were themselves amateur astronomers and therefore could readily communicate with their customers. The ease with which ATMs could buy telescope making materials, various hard to make components (such as telescope eyepieces), and informative books via mail-order catalogues gave a tremendous boost to amateur telescope making, amateur astronomy, and science popularization in the Post-War period.

"'That Graham Cracker Stuff': Human Subjects Research on Hallucinogens in the US Public Health Service"

Nancy D. Campbell

Abstract: Within the context of ongoing scientific work on the underlying mechanisms and processes involved in drug addiction, the United States Public Health Service researchers at the Addiction Research Center (ARC) at the U.S. Narcotic Farm undertook the study of hallucinogens. In 1947, director Harris Isbell brought LSD to the laboratory for study in both animal and human subjects. Prior to, during, and after the period when the CIA-funded MKULTRA studies were conducted throughout the country (1953-1963), the ARC studied LSD-25 to determine its usefulness as a temporary or "model" psychosis; to determine which neural pathways were involved and why the drug effects were so different from those of the opioids typically studied in this research network. Well into the 1970s, the ARC studied LSD to discover whether "bad trips" could be cushioned or curtailed by tranquilizers, reserpine, or chlorpromazine, and to discover how its effects compared to those of psilocybin or mescaline. The laboratory-based science of the ARC stood in marked contrast to other studies conducted by the military and intelligence communities. This paper is based on documentation of the ARC studies obtained through the Freedom of Information Act. It will describe the human subjects protocols, assessing claims as to whether and how subjects involved were informed about their first uses of these drugs, and what knowledge about the brain emerged as a result of this effort.

"The Sea Freezeth Not": Naturphilosophie and the Arctic

Christopher Carter

Abstract: In recent summers, retreating Arctic sea ice has opened the traditional northwest and northeast passages to Asia long sought by European explorers. Although this phenomenon is symptomatic of modern changes in climate, as recently as the nineteenth century it was a commonly held tenet among scientists and explorers that the Arctic was regularly free of ice. This theory of an open polar sea encouraged Arctic exploration and the search for a shorter navigable route to Asia via the North Pole. While generally dismissed by historians as a romantic fantasy, the theory of an open polar sea fit into the context of a more unified view of the natural world developing in the early nineteenth century and exemplified by the philosophical ideas of Naturphilosophie and Humboldt's dictum that all of nature was interrelated. Oersted's discovery of electromagnetism encouraged research into the possible connections between electricity, magnetism, heat and light. At the same time, there was renewed interest in geomagnetism inspired by Hansteen's revival of Halley's four-pole theory of the earth's magnetic field. Incorporating these works into a new theory of the earth's climate created a space for an ice-free Arctic by allowing a milder climate in the high latitudes. This attempt to fuse the study of meteorology and geomagnetism reinforced existing beliefs in an open polar sea and placed this sailor's dream into a holistic worldview that joined different natural phenomena in an effort to find one unifying principle behind all of nature.

John Herschel and the Beginnings of Double Star Astronomy

Stephen Case

Abstract: When William Herschel (1738-1822) began observing double stars, he presented them as a separate class of celestial objects in his natural historical approach to studying the heavens. As research on double stars began in earnest in the early decades of the nineteenth century, other astronomers such as F. G. W. Struve (1793-1864) viewed double stars primarily as targets for precise positional astronomy and the development of new mathematical methods for calculating orbits, a transition seen as a departure from William Herschel's qualitative method to a more quantitative approach. In the work of William's son John, however, these two approaches were not mutually exclusive. John Herschel (1792-1871) pursued the technical aspects of precision double star observations (publishing multiple double star catalogues and devising a graphical method for determining orbital periods) while simultaneously engaging in private and public speculation on the nature of the bodies themselves. My paper examines how John Herschel's thoughts on the nature of these bodies motivated his technical work and vice versa. It will also explore the ways in which he used these different considerations to situate his work in popular and technical scientific discourse and how this discourse changed as stellar parallax established star distances.

Managing Public Anxiety: The Human Genome Project and the National Institutes of Health' s Ethical, Legal, and Social Implications Program

Brian Casey

Abstract: The human genome project was unique not only in the scientific leap it represented but also in the foresight it displayed. Organizers of the genome project set up an unprecedented vehicle in an attempt to prevent public controversies about the project, the Ethical, Legal, and Social Implications Program. Never before had a major scientific enterprise been paired with a program devoted to studying its philosophical and practical ramifications. Through research projects, conferences, and workshops, the ELSI program addressed issues of privacy, population screening, discrimination, and the emotional impact of genetic testing, as well as the cultural, gender, and academic/commercial implications of genetic research. ELSI programs helped develop school curricula from kindergarten to university and offered recommendations to policymakers. Lawmakers took into consideration ELSI reports in the crafting of bills against genetic discrimination in health insurance. This talk will explore the history that made the ELSI program both possible and desirable. It will situate the program in NIH's long history of bioethical reforms in the face of real or imagined scandals. It will discuss the influence the program had on public portrayals of the human genome project and its significance, and will further assess the public portrayal of the ELSI program itself. This talk will also investigate the concern raised by some scholars that the ELSI program served to further divorce science from its implications and scientists from bioethics. The ELSI program, it has been charged, was of no concern to geneticists.

Genetic Screening and Prospective Studies in the Early History of Medical Genetics: Practices and Controversies

Soraya de Chadarevian

Abstract: Starting in the late 1950s, the clinical study of human chromosomes involved large scale screening programs and prospective studies in a few selected centers in various countries, including Britain, France, the US and Canada. Some of these, like the prospective study of XYY individuals, identified through neo-natal screening programs, became highly contentious. While the neo-natal screening programs were discontinued, other population screening programs and especially the prospective studies continued well into the 1990s. In my paper I will review some of these early studies, the aims they pursued, the tools they employed, the scientific and ethical controversies that they sparked and their long term legacies for genetic screening programs of human populations.

Unearthing Science and Early Networks

Mark M. Chambers

Abstract: In 1798, while the Spanish still controlled the Louisiana Territory, American and British miners immigrated and established a settlement near the lead mines. Most importantly, they conducted laboratory and field observations at ten local mines by transferring European mineralogical and chemical techniques in order to analyze and redefine the mining district in terms that merchants and naturalists back east understood. Their mineralogical survey represents a commitment to use scientific and technical means to promote the regions resource potential, which also began the transition from early Native American environmental knowledge to European environmental knowledge and prospecting techniques. This paper argues that the survey offered a view of miners and natural philosophers desiring to reveal "the great wealth which lies buried in the earth." Indeed, this paper examines how early nineteenth-century miners created a network to conduct field "experiments" in small-scale laboratories to produce new scientific knowledge to control the Missouri Territory's natural resources. The management of these early experiments, by American and English miners, also exposes how their practices dismissed Native American environmental knowledge and technical skills, because they thought the prudent way to unearth a regions resource potential was to apply European scientific practices.

The Science and Transformation of Sex in Republican China

Howard H. Chiang

Abstract: In the aftermath of the New Culture Movement (1915-19), Western-trained biologists in China helped establish a popular understanding of sex dimorphism that construed bodily morphology and function of the two sexes as opposite, complementary, and fundamentally different. Starting in the mid-1920s, urban Chinese intelligentsia began to construct a more fluid definition of humanity. They argued that at base, all humans are equal. They no longer drew on the limited language of anatomy to talk about two different but equal sexes. Rather, they started to think of men and women as simply two versions of a universal human body. They appropriated from Western endocrinologists the theory of universal bisexuality, which posits that

everyone is partly male and partly female. This paper shows that a vibrant discourse about "sex change" existed in the mass circulation press of Republican China (from the 1920s through the 1940s). It traces how Chinese sexologists entertained the possibility of sex transformation based on a new hormonal vision of universal bisexuality and famous animal sex reversal experiments in Europe; it demonstrates how indigenous Chinese frameworks for understanding reproductive anomalies (e.g., hermaphrodites, eunuchs, etc.) provided an epistemological point of reference for communicating new and foreign ideas about sex; it assesses the impact of a highly sensationalized case of "female-to-male" transformation in mid-1930s Shanghai on people's awareness of the possibility of human sex change; and it analyzes the culminating effects of these epistemological reorientations in a science fiction short story called "Sex Change" (1940) by the pedagogical writer Gu Junzheng.

Imagined Networks

Wendy Hui Kyong Chun

Abstract: Networks" has become a defining concept of our epoch. From high-speed financial networks that erode national sovereignty to networking sites like facebook.com that transform the meaning of the word "friend," networks allegedly encapsulate the "new." Much theoretical work in the humanities and social sciences has claimed that networks are the diagram for our current institutions: from Jean François Lyotard's description of the postmodern self as a "nodal point" to Michael Hardt and Antonio Negri's examination of U.S. sovereignty as a form of "network power. This paper asks: why? That is, rather than debating whether or not networks really are new and overpowering, it asks why have they become so privileged? What is explanatory power of networks. Networks are an odd, almost contagious concept. Networks are both actually existing realities and theoretical abstractions. They are both diagrammatic planning tools and what results from these tools; further, they are both description and elucidation—they are theoretical in all senses of the word theoretical. Networks also make porous the boundaries between the many disciplines that employ networks, from economics to media studies, from political science to biology. The study of networks thus oddly mirrors its subject: the examination of networks seems to lead to the formation of networks, making it even more difficult to separate network analyses from networks themselves. To understand the power of networks, this paper argues for the importance of images and the imagination, for they are key to transforming networks from planning devices to lived experiences. Spanning the fields of new media studies and science and technology studies, "Imagined Networks" focuses on recent political crises to argue that social networking sites create new collectives that operate via a plural imagined "you," rather than a collective "we."

Al-Ghazālī's Reformation in Islamic Science: Redefining the Uses and Limits of Reason

John Cirilli

Abstract: Abstract: Al-Ghazālī has a reputation as the theologian who wrote The Incoherence of the Philosophers and thereby crippled science and philosophy in the Islamic world, entrenching hegemonic anti-scientific orthodoxy. George Saliba has argued convincingly that to the contrary the centuries following al-Ghazālī's death witnessed not decline but breathtaking advances in science, including Islamic Astronomy's "Golden Age." The two may in fact relate causally, as a

close reading of the Incoherence indicates that reform not destruction was al-Ghazālī's intent and juxtaposition with later texts suggests that Al-Ghazālī contributed fundamentally to subsequent developments in falsafa. Al-Ghazālī, who believed even divine omnipotence accountable to logic and geometry and arithmetic "beyond doubt," saw no problem in a theologian/jurist bringing reason to bear against those who claimed to be its masters. The Incoherence contains point-by-point critiques of specific philosophical arguments, deconstructing positions down to their founding assumptions, undermining apodicticity and highlighting uncomfortable implications. When metaphysicians' reasoning led to blasphemy or just the indemonstrable, he indicated they should leave metaphysics to theologians. Denying Aristotelian necessity delimited the scopes of philosophical and natural inquiry, incorporating the first more into specifically religious intellectual pursuits and directing the second to discovering nature's regularities inductively. Al-Ghazālī advocated metaphysically tentative natural inquiry bearing perhaps a family resemblance to the work of later astronomers (many of the Maragha School), in logical consistency and especially in metaphysical reserve. Al-Ghazālī's impact was both validating and transformative of Islamic science, remapping disciplinary domains and contributing, perhaps, to a distinct and distinctive astronomical tradition.

Popular Cybernetics and the Human Sciences in the Counterculture

Peter Sachs Collopy

Abstract: Although the historiography of cybernetics has focused on technical experts who exported ways of knowing about the world from military research to disciplines from genetics to economics, cybernetics was also popular science. This was true both in the sense that cybernetics appealed to a broad audience, and in the more substantial sense that actors without scientific credentials or affiliations also appropriated these new ways of knowing. This phenomenon reached its peak in the late 1960s and early 1970s, when non-scientists, particularly in the American counterculture, produced their own cybernetic ideas about psychology, politics, and media. Prominent among these vernacular cyberneticians were experimental videographers who interpreted their video cameras and artistic practices in explicitly cybernetic terms. Starting in 1968, activists, artists, and hobbyists came to see new portable video cameras as tools for political and artistic revolution. Video was fundamentally different from film, they argued, because it could be played back immediately, offering a form of cybernetic feedback. Although they referred to Norbert Wiener and other mathematically-oriented cyberneticians in their magazine Radical Software and books like Guerrilla Television, experimental videographers drew more from cybernetic thinkers working in the human sciences. The most influential of these was anthropologist Gregory Bateson, who himself published his ideas about the "ecology of human civilization" in Radical Software. This paper will explore how videographers translated his ideas into political and artistic practice as they sought to use video to intervene in ecology and society.

Heredity Clinics: Hybrid Institutes of Human Genetics

Nathaniel Comfort

Abstract: Within months of the closing of the Cold Spring Harbor Eugenics Record Office at the end of 1939, a new, hybrid type of institution emerged that fused eugenic aims with clinical

medicine. Called heredity clinics by Lee R. Dice, who directed one of the first, they grew in number through the 1940s, spreading across the country and training the men and women who are counted among the pioneers of medical genetics. Tracing the development of the heredity clinics through the 1940s and 1950s illuminates a critical and underexamined moment in human genetics. It reveals that the field's medical turn predated the professionalization and technical advances of the "long 1960s." It de-exceptionalizes eugenics by showing that aims of hereditary improvement were completely compatible with more clinical objectives. And it allows me to capture the confluence of medical and scientific practice, with their-often different methods, aims, and values, at a key moment in the development of biomedicine.

The Wealth of Notions: The Evolutionary Epistemology of William James

Henry M. Cowles

Abstract: It would be hard to overstate the importance of Darwinian evolutionism on the "founders" of American Pragmatism, and especially on the thought of William James. Scholars have worked out a number of specific strands connecting Darwin and James, and this paper is meant to both complement and complicate these received approaches. Rather than trace Darwinian influences in James' theory of mind, it highlights the complex ways in which evolutionism both shaped his vision of epistemic structures external to the individual mind and suggested itself as a model on which to build a new "seat of authority" for intellectual culture more generally. To do this, the paper pays particular attention to James' development and defense of the "pragmatic method," insisting that his methodological concerns follow not (or at least, not only) from an engagement with longstanding efforts to define the scientific method within philosophy, but rather from an evolutionary epistemology in which the reality of an insurmountable welter of ideas requires that individuals adopt methods of discernment in order to navigate the world. This approach gives new meaning to James' famous formulation of the sensory world as a "blooming, buzzing confusing," tying it directly to Darwin's metaphor of the "tangled bank" and expanding out to propose a new means of linking James' earlier scientific work with his later, more strictly "philosophical" work. In doing so, this paper proposes (as its title suggests) a new metaphor for thinking about the relationship between "structure" and "agency" in historical-epistemological science studies.

The Political Life of Mutagens: A History of the Ames Test

Angela N. H. Creager

Abstract: In 1973, Bruce N. Ames, a professor of biochemistry at the University of California, Berkeley, introduced a petri-dish assay for use in assessing the cancer-causing properties of chemical substances. Ames rapidly showed the effectiveness of his test, which used four mutant strains of Salmonella, for identifying known chemical carcinogens. He advocated its utilization in assessing the cancer risks posed by both unknown and known substances, and demonstrated its value by detecting the potential carcinogenicity of a new food preservative, hair dyes, flame retardants being incorporated into children's pajamas, and a condensate of cigarette smoke. Companies immediately began adopting the Ames test as a way to undertake routine chemical screening, and environmental groups were enthusiastic about the test as well. Many toxicologists, particularly those that advocated animal models for screening, objected to Ames's

assumption that the principal cause of cancer was somatic mutation. But these objections were minor compared to the political controversy that developed around the test in the 1980s, after Bruce Ames decided to begin testing natural substances, such as extracts of vegetables and caffeine. His assays showed extracts from many foods and beverages to be just as mutagenic as synthetic chemicals. On this basis he began arguing against new industry regulations, even as he was being appointed to government panels to interpret and implement safety standards. This paper will situate the invention of the Ames test in terms of his own experimental trajectory in biochemical genetics and against the broader context of postwar genetics, environmentalism, and government regulation.

Time, Physics, and Philosophy: The Discovery of CP Violation

Lisa Crystal

Abstract: In 1964, particle physicists Val Fitch and James Cronin conducted an experiment at Brookhaven National Laboratory in Upton, New York. The experiment involved the production of neutral kaons in a particle accelerator and an analysis of the decay products. The results showed that CP-symmetry, a symmetry principle that had been taken for granted by the particle physics community, is occasionally violated. This discovery earned Fitch and Cronin the 1980 Nobel Prize in Physics. In the years following the experiment, both Fitch and Cronin referenced the implied violation of another symmetry principle – time-reversal symmetry – when explaining why their experiment was significant. They explained that the implied violation of time-reversal symmetry meant that their experiment provided insight into the concept of time, and therefore concerned nature at its most fundamental level. However, they never elaborated on how their experiment affected the concept of time, deliberately choosing to abstain from any line of thought that could be construed as "philosophical". This paper considers Fitch and Cronin's 1964 discovery of CP-violation, and the implied violation of time-reversal symmetry, paying close attention to how these two physicists understood the boundary between philosophy and particle physics. It goes on to show how this boundary contributed to Fitch and Cronin's self-understandings as physicists who both dealt with nature's loftiest mysteries and practiced down-to-earth science. I argue that this case provides insight the ways in which particle physicists in postwar America understood the nature and purpose of their discipline.

The Atomic Farmer in his Gamma Garden: Agricultural Research at the Brookhaven National Laboratory, 1945-1955

Helen Curry

Abstract: In 1947, two biologists at the Brookhaven National Laboratory collaborated in the creation of what would become known as the "gamma garden," a field in which they planted experimental crops around a highly radioactive source so that these would be continuously exposed to radiation. From an in-house investigation into the effects of radiation on genes, chromosomes, and whole plants, the garden soon morphed into the site of an extensive cooperative agricultural research program. Plant breeders from around the country and eventually the globe sent seeds and plants to be irradiated in the gamma garden or at other Brookhaven facilities. They hoped that exposure to radiation would quickly generate genetic mutations, useful variations with which they could create improved crops. This paper explores

the development of the agricultural program at Brookhaven, in relation to not only the histories of plant breeding and genetics but also atomic age science. By situating the Brookhaven work among other research sponsored by the U.S. Atomic Energy Commission, the paper argues that this work advanced particular aims of the commission much as it reflected the needs of agriculture, the interests of the researchers involved, and the goals of the newly established Brookhaven laboratory. Not only did it demonstrate an unequivocally peaceful application of atomic energy, but it also counterbalanced growing concerns about the harmful effects of nuclear fallout – for the Brookhaven scientists reported faster and more effective improvement of crops through precisely the process of radiation-induced genetic mutation that many Americans had come to fear.

All Diseases Arise from the Liver: An Historical Epistemology of the Treatment of Emotional Disorders in Kampo Medicine

Keiko Daidoji

Abstract: In many contemporary Japanese Kampo texts, psycho-emotional problems are typically diagnosed as a problem of constraint and treated with formulas that contain the herb chaihu to treat the Liver. Unlike China and Korea where the treatment of emotional disorders has a strong historical connection to the 20th century encounter with biomedicine, Kampo formulas originate with Japanese innovations in traditional medicine. This paper will focus on one of the key figures that helped produce these new understandings of the body, the late Edo period physician Wada Tokaku (1742-1803), known for establishing a unique pathology that ascribes all diseases to the liver. Wada drew on both the Ancient Formulas school, which advocated a strict adherence to the formulas of the revered Han dynasty doctor, Zhang Zhongjing, and the more speculative Later Masters school, based on the medical writings of the 14th century scholar, Zhu Danxi, to craft his treatments of emotional disorders. Wada explains that liver constraint, the state in which liver qi loses its “tension,” is the fundamental pathology of most emotional disorders. Although Wada's treatments, which include "talking therapy," are quite distinct from modern Kampo treatments, he is an important transitional figure in the contemporary therapies for pyschogenic illnesses.

The Settling of Copernicanism: The Burden of Proof and the World of the Future

Peter Dear

Abstract: The Copernican Question finishes with consideration of the framings found in discussions of astronomical systems in the middle and latter parts of the seventeenth century. By focusing on the arguments of Giambattista Riccioli, Peter Dear will argue that prognostication was freed from its chronic astrological difficulties by giving way, as Westman argues, to "social-scientific" predictive techniques, thereby allowing Copernicanism to abandon the rigors imposed by assumed astral influences.

The Geometer in the Machine: Diagrammatic Heuristics and Early Automated Theorem Proving

Stephanie Dick

Abstract: Early researchers in Artificial Intelligence were not only interested in creating machines that could perform various tasks. They were also interested in modeling and understanding the human mind and various human practices, ranging from Chess playing to mathematical theorem proving. This paper explores an effort in early AI research from the mid-twentieth century that aimed at producing a geometry-theorem proving and geometry problem-solving computer program. Usually, the heuristic function of geometric diagrams is tied to the human's visual sensibilities and spatial intuition. Computers, at least at that time, were lacking in any traditional version of these faculties. Researchers nonetheless aimed to exploit the "potent heuristic properties of [the] diagram" in helping their machines "distinguish the true from the false sequences" (Herbert Gelernter, 1959). By investigating both how Gelernter's geometry-theorem proving machine worked and how it was described and interpreted, I unpack some of the very interesting questions raised by the exportation of human mathematical heuristics devices to computers. Early Automated Theorem Proving research serves as a powerful site for simultaneously revealing and reconfiguring assumptions about human mathematical practice and pedagogy. This discussion participates in wider Science Studies conversations about human-machine interaction, distributed and extended cognition, material agency, technological discourse, and computer-assisted knowledge making posed by, for example, Lucy Suchman, Brian Rotman, Harry Collins, and Donald MacKenzie.

Fabricius' Aristotelian Mechanization of Animal Progression

Peter Distelzweig

Abstract: Hieronymus Fabricius ab Aquapendente [Girolamo Fabrizio] has attracted the attention of historians of science as an important contributor to the renaissance of anatomical studies in the 16th century. Andrew Cunningham has done much to help us understand Fabricius' Aristotelian approach to anatomical research at the University of Padua. In addition, because of his work on animal locomotion, and later reference to him by Giovanni Borelli, he has come to the attention of scholars working on the rise of biomechanics and attempting to trace the rise of mechanics in the 17th century (e.g., Jaynes, Baldini). However, these two features have not been adequately brought into discussion. In this paper, I carefully examine how Fabricius attempts to integrate mathematical mechanics into his "Aristotle Project" in anatomy. I focus especially on his *De musculi utilitatibus*, but look also at his other works on muscle and bone anatomy and animal locomotion. I begin by giving my own characterization of Fabricius' approach to anatomical research (disagreeing slightly with Cunningham's approach). Then, connecting his approach to suggestions found in the work of his colleague, Giuseppe Moletti (Chair of Mathematics), I argue that Fabricius'attempts to integrate mathematical mechanical reasoning into his "Aristotle Project" is partial. While he does attempt to find a place for mechanics in his teleological explanations of muscle anatomy, he does so in a piecemeal way, offering parallel and at times conflicting "natural" and "mechanical" explanations of the same features.

"Can There Be a Science of Bibliotherapy?": Reading as Treatment in United States Hospitals, 1935-1940

Monique Dufour

Abstract: Bibliotherapy entails the use of books and reading to promote healing and well-being. The notion that reading can affect one's mind, body and spirit traces back at least to the ancient Library at Thebes—over its doors was carved "the medicine chest of the soul." However, in the United States during the 1930s, bibliotherapy had a specific meaning and historical instantiation, as it became a prevalent, contested therapeutic method practiced in veterans' hospitals, private hospitals and mental health facilities. In this paper, I will describe and analyze debates about bibliotherapy during this period, debates that centered on the contested role of science in adjudicating the use of reading as therapy in medical practices. By 1935, some doctors, researchers and librarians expressed concern about the scientific basis of bibliotherapeutic practices and claims, leading to ask, like the title of a 1939 article, "Can There Be A Science of Bibliotherapy?" I will describe and analyze their ensuing attempts to define, apply and evaluate bibliotherapy scientifically. The study of bibliotherapy, I argue, allows us to explore a significant and compelling intersection between science, medicine and society. Books and reading were, after all, commonplace objects and practices with potent cultural meanings and norms. I will explain how definitions, practices, meanings and assessments of books and reading were negotiated in medical environments. Further, I will argue that these negotiations shed light on fundamental conceptions of the patient, definitions of health, processes of healing, the stakes of standardization, and the boundaries between science and culture.

Clandestine Revival of the Prague Linguistic Circle in Prague, 1945-1968

Helena Durnova

Abstract: In the decade preceding World War II, the so-called Prague Linguistic Circle (Prague linguistic school) developed the ideas of Ferdinand de Saussure. While the original circle practically ceased to exist during World War II, its ideas were clandestinely revived and developed during the rule of the Communist Party of Czechoslovakia (1948-1989). Just after WWII, digital computers were entering the scene, promising to provide researchers of all branches with a powerful tool. Linguists, like other researchers, were not entirely united as to their hopes in the new technology. In the Soviet bloc, the visions of using the computer were also influenced by the ideological pertinence of such use. While the use of computers by mathematicians, astronomers, physicists, and engineers was undisputed, using computers to aid linguists was not supported in the early 1950s. Expelled from the Faculty of Arts for their wishes to do linguistics on computers, the Circle found refuge at the Faculty of Mathematics and Physics. While initially the linguists took their new location only as a substitute for the desired one, they gradually won their position among linguists abroad and, after 1989, revived the original name. The presentation will focus on the effects of this forced institutional position of linguists close to the departments of mathematics and computer science and will analyze the development of computer-based linguistics in this context.

Leveraging Science against Sovereignty: Dai Dong's Menton Statement and Third-World Conflict

Roger Eardley-Pryor

Abstract: Upon emerging from the pacifist Fellowship of Reconciliation in 1969, an international NGO named Dai Dong sought to leverage the authority of biologists and ecologists to highlight the need for peaceful, planetary change if humanity was to survive the increased onslaught of environmental destruction, social exploitation, and escalating war. In 1971, Dai Dong's creation and global distribution of the Menton Statement, written by a collection of biologists, captured worldwide headlines and garnered support from thousands of the world's experts on environmental science, including Nobel laureates like Salvador E. Luria, Albert Szent-Gyorgyi, and George Wald. The Menton Statement helped Dai Dong influence United Nations policy-makers, like U Thant and Maurice Strong, by encouraging the United Nations to include greater scientific expertise in its preparations for the upcoming 1972 UN Conference on the Human Environment in Stockholm. Building on this success, in 1972, Dai Dong held an Independent Environmental Conference in Stockholm, aiming to overcome the limitations of national sovereignty inherent in the UN. At Stockholm, however, the Third-World biologists attending this alternative conference highlighted how Dai Dong's ideas overlooked the political realities of the developing world, particularly regarding national sovereignty and population planning, leading to Dai Dong's collapse in 1974. This paper argues that Dai Dong mistakenly rooted its systems-oriented vision of global problems with industrialized-world bias; and, it compares Dai Dongs failures regarding transnationalism with the success of Friends of the Earth, another international environmental NGO that also emerged in 1969.

Pictorial Statistics

Josh Ellenbogen

Abstract: This talk will examine one particular deployment of photography from the late nineteenth century, Francis Galton’s famous use of the medium. It will demonstrate that, in Galton’s project, photography diverged from its more typical use—the registration of evidence that existed apart from photographic technology, evidence from which investigators could subsequently develop synthetic claims about the world. Instead, Galton aimed to make photography itself function synthetically, visualizing lawful patterns in human population groups. This use of photography saw the medium function as what Galton called “pictorial statistics,” presenting the mathematical regularities that prevailed within a given order of entities, but regularities that could only be made evident in a visual, photographic form.

Teaching Science through its History, and History through Practice

Jamie Elwick

Abstract: For the past 30 years historians of science have insisted that science involves at least as much tacit and craft knowledge as it does ideas. Unfortunately the setup of the average lecture hall - with nary a cyclotron, scalpel or even hot plate - makes it difficult for non-science students to gain any hands-on experience for themselves. Lacking a lab of one's own, or even equipment, what are some options for getting a relatively large class of such students to experience some

basic form of scientific practice? This paper is about a new and idealistic lecturer's attempts to improvise a solution.

New Perspectives in the History of Forensic Psychiatry

Eric Engstrom

Abstract: The history of forensic psychiatry, like the contemporary specialty itself, is truly a *mixtum compositum*. Recent studies have demonstrated that the traditional research paradigms of modernization, medicalization, and professionalization fail adequately to capture the historical complexity and contingency of forensic practices and experiences. Recognizing these difficulties poses a daunting challenge for historians, forcing them to reassess their stock narratives in many different ways. One way of thinking about these problems is to consider the historiographic environments in which histories of forensic psychiatry have operated. Traditionally, forensic psychiatry has been approached from several more or less well established domains of inquiry, each populated with its own indigenous themes and methodologies. The paper will briefly sketch three such domains - social history, history of medicine, and the history of professions. It will argue that we need to be cognizant of these different domains and take seriously questions about the relationships between them. It will also examine some of the more hybrid historiographic strategies that do not simply ignore these domains, but that are robust enough to both tap into their rich traditions and to overcome their respective limitations to produce narratives of greater depth and sophistication. Increasingly, these strategies are turning to study the various thresholds of forensic psychiatry along the seams of practice and experience, exploring how heterogeneous arrays of concepts, images, and materials are exchanged and circulated and how, in the process, they shape forensic psychiatry's situative dispositions.

Two Conceptions of Geometry in Kepler

Jorge M. Escobar

Abstract: One can distinguish two conceptions of geometry in Kepler's work. In the scientific conception, geometry deals with familiar things such as axioms, theorems, and demonstrations, and is subordinated to physics when it is applied to the examination of natural phenomena. In the metaphysical conception, geometry deals with the constitution of reality, namely, God, soul, and world. I argue that in the metaphysical conception, physics, particularly concerning the theory of matter, is subordinated to geometry. In this conception of geometry, Kepler conceived of the world as geometry materialized, or in other words, matter was a geometrical entity, which entailed that doing physics was, metaphysically speaking, a way of doing geometry. These two conceptions of geometry point to two different lines of research for Kepler studies. One line, historical, is the study of the relation between Keplerian and Cartesian metaphysical conceptions of geometry. Contrary to what others have suggested, I think that it is worth investigating the Cartesian conception as arising not in opposition to the Keplerian conception, but in agreement with it. The other line, philosophical, is the evaluation of the coherence of both conceptions of geometry in Kepler's natural philosophy. Though it has been rightly suggested that at the end of his career, it became increasingly hard for Kepler to defend that coherence, I think that he still had the theoretical resources to do it.

Glass Science: Boundary Work in Laboratory Research, 1860–1935

Kijan Malte Espahangizi

Abstract: Glass vessels play an ambiguous role in the historiography of laboratory research. Historians of science typically construe laboratory glassware as ahistorical quasi-immaterial bodies, whose properties they limit to form, transparency, neutrality, and at best to annoying fragility. But this popular image of a transparent experimental container obstructs the view on the historicity and physico-chemical functionality of this constitutive inner boundary in modern laboratory environments. In contrast to that, I will ask how glass vessels perform the complex causal containment of the spatially enclosed experimental phenomena in research habitats. Approaching the history of laboratory research from this marginal perspective, I examine the painstaking efforts to demarcate experimental boundaries in late 19th and early 20th century. Since the 1860s, the ongoing professionalization of exact laboratory research and with it the diverse and intensive use of glassware created a new awareness in the scientific community of measurement errors caused by glass vessels. The physico-chemical interaction of glass and water troubled laboratory sciences like chemistry, gasometry, physical chemistry, cathode ray physics, cell physiology, bacteriology, medicine, and pharmacology. Focusing especially on the chemical laboratory of the German Physikalisch-Technische Reichsanstalt led by Franz Mylius I will explore the collaboration between experimentalists, glass science, glass container industry and public authorities which aimed at solving the endemic glass boundary problems. I will argue that the new glass theories, modified batches, standardized glass testing methods and classifications of glass quality developed in this context provided important habitat knowledge to the emergence of a modern laboratory research environment.

Greek or Babylonian Solar Theory on the Antikythera Mechanism?

James Evans

Abstract: The front face of the Antikythera mechanism included a circular zodiac scale divided into signs and a concentric calendar scale divided into months of the Egyptian year. Recently published work established that the nonuniform motion of the sun was represented in a very efficient way, simply by nonuniform division of one of the two scales. Although there were theoretical reasons for thinking that it was the zodiac scale that is divided nonuniformly, this could not be directly demonstrated. Nor was it possible to be sure of whether the underlying theory is geometrical or arithmetical. This paper will describe an extensive new study of the scales based on photographs and x-rays of a larger extent of the zodiac, leading to the conclusion that it is indeed the zodiac that is divided nonuniformly. Evidence will be presented that bears on the underlying theory: is it a piecewise linear theory akin to Babylonian System A, or a geometrical theory akin to Hipparchus's eccentric-circle model? The paper will conclude with a discussion of the significance of models of mixed Greek and Babylonian origin on the Antikythera mechanism.

Earthquake Monitoring and Weather Forecast in Communist China: Observation, Experience, and Expertise

Fa-ti Fan

Abstract: This paper examines the politics of epistemology in the programs of earthquake monitoring and weather forecast in Mao's China. During the Great Leap Forward and the Cultural Revolution, the Chinese state pursued programs mobilizing mass participation in weather forecast and earthquake monitoring. These programs were scientific and political campaigns that aimed to produce a modern communist nation-state. The enterprise stressed the value of indigenous, class-based, and experience-based knowledge from the masses, but its professed goal was to integrate this body of knowledge with elite knowledge, namely, knowledge produced by the scientific experts. The paper focuses on the political epistemology of observation and prediction in these programs. It discusses the idea and practice of observation and prediction in relation to both the state and the participants.

The Science and Politics of Old Fish: Ageing, Otoliths, Transformational Science and Fisheries Policy in Canada and the United States

Carmel Finley

Abstract: In the 1930s, when fishermen in both the Atlantic and the Pacific first began to fish at deeper depths, they found large catches of a medium-sized, bright red fish were identified as species of Sebastes, a family of rockfish. An international group of scientists met in Copenhagen in 1959 to sort out the relationship among the various Sebastes species. One of the most important questions was the age of the fish; some thought they might live a decade; others that they might be as much as 50 years old. Sebastes landings escalated rapidly through the 1950s and 1960s, but it would take until the early 1980s for scientists to develop the tools needed to decode the age of the stocks, some of which could live as much as 200 years. Canada incorporated new scientific information into its management plans during the 1990s, but the United States did not, leading to a crash in some rockfish populations after 1996. The development of the science of ageing fish, using their otoliths or ear stones, has been an international process that some scientists believe has the potential to be transformational, capable of revolutionizing existing fields of study. It also might be the key to implementing fishing strategies. This paper examines the incremental nature of the science of ageing fish, and the difficulties of incorporating new science into old policies and rigid legal mandates.

The End of an Evolutionary Biologist: The Spiritualism of George Henslow

Keith Francis

Abstract: George Henslow (1835-1925), the son of Darwin's mentor John Stevens Henslow, was a well-known botanist in his own right. A passionate defender of evolution, he was one of a number of scientists who questioned Darwin's theory of natural selection. In his two books *The Origin of Floral Structures* (1888) and *The Origin of Plant Structures* (1895), he argued that adaptation in plants occurred mainly due to their reaction to environmental conditions, the most important factors being mechanical. Henslow cast a critical eye over a range of topics in science and theology, one of his main concerns being that ideas should only be acceptable if they were

logical. For example, in *Present Day* Rationalism (1903) he explained why evolutionary theory was epistemologically sound and in *The Vulgate the Source of False Doctrines* (1909) he argued that poor translation of the original languages led to some of the superstitious doctrines of the Roman Catholic Church. Given his approach it seems odd that the last two books he wrote were *The Proofs of the Truth of Spiritualism* (1919) and *The Religion of the Spirit World, Written by the Spirits Themselves* (1920). These books were not the ravings of an old man facing death but highlight that, despite the efforts of Huxley, Romanes, and Lankester, the debate among scientists about what constituted scientific knowledge and the limits of that knowledge continued well into the twentieth century. This paper will explain how Henslow's world view enabled him to be both evolutionary biologist and spiritualist.

Prickly Pears and Pagodas: The East India Company's Failure to Establish a Cochineal Industry in Early Colonial India

James Frey

Abstract: In the 18th century, Spain's New World colonies monopolized the production of cochineal, a valuable red dye. The dye was derived from *Dactylopius coccus*, an insect associated with cactus plants. Although native to Mexico, the optimal environment of the cochineal insect was *Opuntia ficus-indica*, better known as the prickly pear cactus. The Portuguese had transplanted the species to India in the 16th or 17th centuries, and in the late 18th century British botanists studying South India's flora discovered an Indian variant of *Dactylopius coccus* living on *Opuntia*, which was mainly grown in hedges. At the time, the East India Company was investing in botanical research, hoping to discover new resources and develop new industries. Convinced that cochineal manufacturing could be established in India, Dr. James Anderson, in consultation with Sir Joseph Banks, undertook the propagation of *Opuntia* in botanical gardens, and attempted to introduce *Dactylopius coccus* from Mexico. As an incentive, would-be Indian *Opuntia* farmers were offered one pagoda – a substantial sum – for every pound of cochineal produced. However, while cochineal eventually was exported, it was no match, in quality or price, for the Mexican product. This paper explores the origin and trajectory of the East India Company's global, cross-cultural cochineal experiment, considering the problem of Enlightenment projects that fail, and what such failures tell us about late 18th century science.

Toward an Anatomy of Ignorance in Environmental Risk Assessment

Scott Frickel

Abstract: This paper examines aspects of the regulatory response to suspected chemical hazards in New Orleans, Louisiana following the city's catastrophic flooding from Hurricane Katrina in August 2005. I use the case to investigate the social production of ignorance as it shapes risk assessment policy and practice in the U.S. Where much of the recent historical work on ignorance conceptualizes the absence of knowledge as an intended consequence of interest-driven purposeful action (e.g. secrecy, deceit, suppression), here I argue that ignorance can also operate as the unintended consequence of specific but distinct logics of knowledge production – logics that seek to maximize what I call "epistemic efficiency" and "epistemic reach" in regulatory responses to catastrophic disaster. I offer analyses of Environmental Protection Agency and Louisiana Department of Environmental Quality policy documents and memos,

EPA health information databases, and EPA test data from New Orleans to trace bureaucratic productions of ignorance within the epistemic machinery that organizes and reproduces environmental regulatory practice. Through this "anatomical" approach, I document empirically and systematically how complementary logics generated a multidimensional "body" of ignorance whereby different forms of non-knowledge combined in complex ways—politically, temporally, and spatially—to seed new forms of environmental inequality in the yards, parks, and playgrounds of the Crescent City.

The Making of Place: Richard Bradley's Studies of Soil, Climate and Garden History

Yvonne Gaspar

Abstract: In the preface to *New Improvements of Planting and Gardening* (1717), the horticulturalist Richard Bradley observed that despite "their Pains in Collecting from Antiquity and Foreign Soils" scholars failed to contribute to practical knowledge. This was because they worked "without carefully considering wherein their Experiments differ from the Genius of our Soils and Climates." It is perhaps unremarkable that Bradley's call was echoed in Alexander Pope's famous invitation to attend to the "Genius of the Place" in his Epistle to Richard Boyle, Third Earl of Burlington. This expression has frequently been regarded as fundamental to the emergence of the Natural Style through which English designers would become leaders of a new ethic of gardening that broke from the geometric uniformity of Italy and France. Although the contribution of horticultural improvements to changes in landscape design is well known, many authors have been dismissive of the relevance of botanical research for these revolutionary developments. As a consequence, the importance of the concept of *genius loci*, so essential for contemporary developments in landscape design, has not been considered in studies of eighteenth-century plant sciences. This paper examines Bradly's investigation of soil, climate and the manipulation of conditions to correct for differences in latitude within the context of contemporary aesthetic influences. I will argue that Bradley's study was deeply sympathetic to that of contemporary painters and poets in seeking to articulate a new relationship between past and present based on a heightened awareness of the contours and composition of the local land.

The Monkey in the Panopticon: David Ferrier's Utilitarian Neurology

Cathy Gere

Abstract: In 1876 the physiologist David Ferrier published the first 'map' of the human brain, extrapolated from the sensory-motor cortex of the macaque monkey. Ferrier's neural cartography, based on five years of animal experiments, is celebrated in the history of the neurosciences as the first truly scientific exploration of the localization of brain function. This paper will situate Ferrier's neurological treatise in its political and historical context, arguing that it represented the scientific naturalization of a Utilitarian understanding of the human condition. Ferrier was the heir of an intellectual tradition that reached back to Jeremy Bentham via the devoutly Utilitarian philosopher of mind Alexander Bain. Accordingly, his sensory motor psychology conceived of the human intellect as a system of inputs and outputs, pleasures and pains, stimulus and response, susceptible to systematic experimental investigation. Moreover, the West Riding Lunatic Asylum, where he conducted his experiments, was designed in accordance with the philosophy of surveillance laid out in Jeremy Bentham's plans for the Panopticon. In

1881 Ferrier exhibited one of his macaque monkeys at the Seventh International Medical Congress in London, a demonstration that resulted in a resounding victory for his understanding of brain function. His subsequent trial for practicing vivisection without a license united the scientific establishment in his defense, and arguments about the therapeutic utility of his monkey experiments sealed the success of his neurological framework, thus naturalizing the Utilitarian vision of the human subject.

Natural History Theories

Elihu M. Gerson

Abstract: Natural history exhibits a unique kind of theorizing that distinguishes it from other ways of understanding nature. Developed at the turn of the nineteenth century, this theorizing is based upon systematic analogies, often called "parallels", among systems of classification and between classifications and temporal or spatial sequences. These parallels became of central importance to nineteenth century natural history. The most important parallel consisted of analogies (later called homologies) that associated kinds in the classification of organisms with members in the classification of body parts. This was soon followed by development of parallels between the stratigraphic system of rocks and the kinds of organisms found fossilized in those rocks, between developmental sequence and parts of organisms, between kinds of organism and spatial location, and others. The twentieth century saw the introduction of a classification of geographical regions, and the development of parallels between it and morphology as well as other kinds and sequences. These parallels or mappings among classifications and sequences have all the properties of theories. They can be used to make predictions and support counterfactuals. They reliably pose interesting and fruitful problems to be solved by developing models of the mechanisms that underlie them, and by formal causal analyses. The view of modern natural history that sees it as merely descriptive is therefore inadequate and misleading.

Lamarckism and the Constitution of Sociology

Snait B. Gissis

Abstract: The decades from the 1850s onwards witnessed the beginning and the achievements of evolutionism as a meta-narrative. The resulting discourse often had "progress," "development," and/or "the inheritance of acquired characters" as its principal explanatory terms, rather than natural selection and variations, even though these evolutionary mechanisms were also often present, as well as some extant models of recapitulation. I analyze the emergence of sociology as a discipline in Britain and France during the second half of the 19th century and investigate its conceptual framework by examining the transfer of concepts, models, metaphors and analogies from contemporaneous evolutionary biology. Sociology emerged in continual interaction with this evolutionary biology which, both in France and in Great Britain, had a marked Lamarckian/neo-Lamarckian perspective and emphasis. By analyzing the interactions and transfers between social thought and Lamarckian evolutionary theories insights into the relationships between individuals and collectivities are obtained. This transfer could take place only within a cultural context which allowed for the assumption that there was a fundamental correspondence/similarity/analogy between organic nature and social life, between mechanisms of biological and social development, and between types of regularities observed in both fields.

Within this context I discuss certain aspects of the work of two influential social theorists: Herbert Spencer and Émile Durkheim. In important respects their work was part of a general framework of Lamarckian modes of thought that became significant around mid-19th century, and whose impact lasted until the end of that century.

Building the World's Supply of Quinine: Imperialism, Global Commodities, and Transnational Science

Andrew Goss

Abstract: After 1840, and after colonial governments began regularly providing quinine prophylaxis to its soldiers and officials, the science of quinine became an imperial concern. As imperial governments grew in territory and personnel, they needed ever greater quantities of the malaria drug, an alkaloid derived from the bark of Cinchona. The history of how the cinchona acclimatization initiatives were a race between the French, British and Dutch empires is well known. Less well understood is that as imperial governments employed many self-proclaimed quinine experts in order to create a reliable, ingestible form of the cinchona bark, they spurred the creation of a new field of scientific expertise. Dutch quinine scientists, with connections to colonial officials, academics in the Netherlands, members of the British quinine initiatives, European chemists and botanists, and planters on Java, created institutions that networked scientific expertise, government backing, and private investment, from which they coordinated the creation of processed quinine as a commodity. And not only did the Dutch in the Netherlands East Indies manage to construct quinine institutions which incorporated the diversity of knowledge about quinine and Cinchona; once the quinine processed from cinchona trees grown in the Netherland East Indies colony was effective world-wide, the quinine scientists administered a global commodity. This became the hallmark of the transnational science of quinine: quinine scientists' expertise and authority was built not just on their knowledge about the nature and chemistry of quinine, but on their success overseeing institutions and processes that created a commodity with global efficacy.

Mathematical Astrology and Other Failed Essays of the Scientific Revolution

Rachel Gostenhofer

Abstract: The figure of John Dee in English and Holy Roman imperial courts in the sixteenth century has been one of the most compellingly and effectively mobilized in showing the Renaissance magus as equally scientist and magician. Beginning with the scholarship of Frances Yates, Dee has been used to dramatize the ways in which the repopularization of the Hermetic texts and associated magical practice were key in precipitating the Scientific Revolution. As a result, scholars have focused on his more magus-like activities in his production *of Monas Hieroglyphica* and his acquisition of the putative Smoking Mirror to conduct angel conversations. I would suggest, however, that the most significant text in understanding the complexity of the early modern scientific-magical discourses is best exemplified in his early career work *Propaedeumata Aphoristica* which engages in a far more scientific-sounding discussion of optics than his later material, in an attempt to initiate a quantitative, scientific practice of astrology. This paper will consider some possible implications of Dee's career trajectory from explicit to occult, and from quantitative to qualitative in order to problematize

central elements of the regnant historiography of the Scientific Revolution. I will consider the possibility of a gradual narrowing of focus in a larger intellectual revolution as the applicability of quantitative, replicable methods came to be construed increasingly narrowly, of utility in a small fraction of the disciplines and fields of inquiry in which they were initially deployed.

The Technical and Scientific Activities of the Office of Inter-American Affairs in International Relations Of Latin American Technoscience (1941-1945)

Alexis De Greiff

Abstract: The Office of the Co-ordinator of Inter-American Affairs (OIAA) has been studied, but exclusively in relation to its Pro-American propaganda activities. We are a network of scholars from Colombia, Brazil, Argentina, México, Brasil and Germany, under my co-ordination, that is investigating the initiatives of the Office concerned with science, technology and technical assistance. This is the first comparative study of its kind. Our aim is to explore the role ascribed to science and technology by two industrial powers (USA and Germany) in Latin America during World War Two and the impact of the undertaken projects in the development of Latin American economic, cultural and political relations with the US and Europe after the war. Our research contributes both to the history of international relations as well as to the globalization of knowledge in the twentieth century. We also investigate the role of local actors in the negotiation and stabilization of "development" agendas, particularly in the construction of transport and production infrastructure. In this talk I present the research project upon which we have embarked, its theoretical framework, main hypothesis and the preliminary results. Hence, this is an opportunity and invitation to discuss possible collaborations with other scholars working on similar North-South technoscientific exchanges.

Scientists under MacArthur

Walter E. Grunden

Abstract: During the Allied Occupation of Japan (1945-1952), scientists turned their focus to the reconstruction of the nation, as well as their own reintegration into the international scientific community, from which they generally had been isolated during the war. They were encouraged and assisted in this effort by colleagues in Western nations, and many Japanese scientists were invited to travel and live abroad as visiting scholars and researchers. United States Occupation authorities (SCAP), however, proved less sanguine about the international travel plans of some Japanese scientists. Now influenced by Cold War imperatives, SCAP's original goals of "democratization" and "demilitarization" came to include measures to prevent Japanese scientists from visiting the Soviet Union or known Soviet bloc states, as well as limiting their contact with colleagues in socialist nations. Japanese scientists having known affiliations with leftist organizations, or having expressed sympathy with their causes, were especially suspect. SCAP policy toward these scientists became ideologically oppressive in that those who were identified as "red" were usually denied travel visas, while those who were expressly more sympathetic to the US and its emerging Cold War allies found freedom of movement more easily. This paper will examine SCAP policy toward the reintegration of Japanese scientists into the international scientific community with a particular focus on their efforts to travel abroad during the years 1945-1952. The essay argues that those identified as "leftists" suffered a form of

institutional discrimination under SCAP that may have negatively affected their career opportunities both inside and outside of Japan.

Collaborative Teaching in the Classroom and in the Field: Teaching Evolution and Its History from the Galapagos to the Rainforest

Piers J. Hale

Abstract: History of science can be taught with great benefit to science students in the classroom, but study abroad opportunities present opportunities to take classes into the field—this is becoming all the more so in light of the increased emphasis upon study abroad programs in many universities. This session will introduce the many opportunities as well as the challenges of teaching history and science in the field through my recent experiences of doing exactly this in the Galapagos Islands and in the Ecuadorian rainforest. The focus will be upon the benefits to be derived from an integrated teaching/learning experience for teachers as well as for students.

Perceptual Machines: Cybernetics, Design, and Bio-Politics circa 1959

Orit Halpern

Abstract: In 1959, in the midst of the Cold War, the preeminent designers Charles and Ray Eames produced an installation for the United States Information Agency of novel scope and aesthetics. A massive seven-screen installation within a vast cavern built by the famous American architect and cybernetician, Buckminster Fuller, the piece was to be part of the first "cultural exchange" between the United States and the USSR. A "totally new type of presentation", in the words of Charles and Ray, the installation was envisioned as a "letter" between two cities in a world where writing would no longer suffice. In the face of this imagined textual collapse, the designers believed visual images might serve as a new mode of human interaction. 2200 images were shown on seven screens for 13 minutes. The piece was edited by a pioneer in digital cinema heavily influenced by cybernetics—John Whitney—and the theory behind its construction was based on communication theory and the feedback theories of psychiatrist Kenneth Craik. Beneath the multimedia spectacle was displayed Edward Steichen's "the Family of Man", a photographic essay demonstrating human biological diversity and equivalence through tropes of heterosexual reproduction and nuclear family. Hundreds of thousands, if not millions, of people saw it. Ray Eames called it an "affective experience". This scene introduces three linked concepts as related to governmentality—new media formations, novel ideas about cognition, vision, and perception, and communications theories and cybernetics. But the scene also reveals older histories of nation and population upon which this architecture of affect and attention is layered. These information displays cannibalizing an archive of older normative tropes of biology, sexuality, race, and gender while producing entirely new modes of attention. It is my intention to interrogate this historical relationship between communication science, neuroscience, and design to produce an account of transformations in techniques of governmentality. Starting with this scene in 1959, and linking these designers to cybernetically influenced researchers in neuroscience, cognitive science, and the social sciences, I develop an account of how racial, gendered, and national difference were reconfigured at this moment of history through new strategies of information design and multimedia spectacle.

Quickening Nature's Pulse: Mutation Plant Breeding at the International Atomic Energy Agency

Jacob Darwin Hamlin

Abstract: In the first decades after World War II, mutation breeders seemed poised to use atomic energy to quicken nature's pulse, develop new crop varieties, and transform landscapes. American scientist Lloyd Berkner, president of Associated Universities, once marveled: for evolutionary purposes, American labs had collapsed a thousand years into one. Although skepticism curbed this work in the United States, these programs flourished elsewhere, especially in the developing world. My presentation will highlight the nurturing of mutation plant breeding within the International Atomic Energy Agency (IAEA), which periodically injected support and helped scientists to deflect criticism at home. I investigate the professional and rhetorical strategies among mutation plant breeders during the heyday of peaceful applications in atomic energy. Marginalized by scientific communities in their home countries and often unable to acquire sustained funding, these scientists used the IAEA as a lifeline, to bolster the credibility of their research programs and to gain high-profile attention for their methods. Mutation plant breeding became—through the lens of the IAEA—a socially progressive, ultra-modern science destined to alleviate environmental pressures, with a strong network of researchers. Despite opposition by conventional plant breeders and by other agencies, mutation breeders gained strength from the consistent clarion call from the Vienna-based agency to use atomic energy to understand the natural world and quicken its pulse with radioisotopes. This presentation will be based on archival research at the IAEA and other national and international bodies.

Standards Bound to Disappoint: A Rational Chemical Nomenclature Defeated

Evan Hepler-Smith

Abstract: As the sophistication and commercial importance of organic chemistry grew over the second half of the nineteenth century, so too did the disorder among the names that denoted the rapidly expanding menagerie of organic substances. Blame for the lexical chaos was pinned on the co-existence of numerous less-than-systematic nomenclature conventions. At the 1892 Geneva Nomenclature Congress, leading organic chemists sought to codify a system of standardized nomenclature that would generate a unique name for each substance, corresponding precisely to its constitution, according to a consistent, rational method. The resulting Geneva Nomenclature is commonly considered the origin of today's systematic organic nomenclature. Yet even as the creators of the nomenclature sought to extend its scope, attempts by chemical lexicographers to use Geneva names encountered serious practical and epistemological challenges. By the late 1890s, the new nomenclature faced a mounting opposition that critiqued not only the Geneva system but, more broadly, the desirability of any standardized nomenclature. Even an ideal standardized nomenclature, opponents claimed, would be of less use to chemistry than the existing set of idiosyncratic, equivocal, traditional names. The success of this critique and the abandonment of nomenclature reform until the 1920s was due in large part to the failure of nomenclators' attempts to enforce a division in the linguistic practices of chemistry between areas in which standardization was and was not desirable.

The Psychologist and the Bombardier: The Army Air Force Classification Program in WWII

Marcia Holmes

Abstract: Following the attack on Pearl Harbor in December 1941, the Army Air Force‘s (AAF) newly created Aviation Psychology Research Program rapidly rose to prominence and played a critical role in the history of applied psychology. The program gave psychologists an unprecedented opportunity to show the value of their discipline as they aided the AAF in developing examinations that would identify, evaluate, and classify promising aviators according to their aptitude to be successful pilots, navigators, or bombardiers. Yet while psychologists enjoyed initial success in creating classification procedures for pilots and navigators, they were frustrated in their attempts to design valid tests for evaluating skill in bombardiering. Despite displaying skill based on standard methods of psychological profiling, bombardiers routinely failed to adequately execute their mission in the field for reasons both within and beyond their control, including pilot or navigator error, extreme temperature or weather conditions, or mechanical defects in equipment. This complicated relationship between men and their machines in the task of precision bombing posed a new set of problems that traditional methods of psychological investigation seemed inadequate to address. My paper focuses on the implications of the man-machine relationship in precision bombing for the developing field of applied psychology, particularly as psychologists attempted to prove the import of their classification research to the AAF. I argue that psychologists' success ultimately lay in how closely their analysis fed into AAF propaganda that depicted the Air Force as distinctive in its reliance on teams of specialists who operated high-technology machines.

‘These Men Are, Believe It or Not, Scientists’: Science in British Newsreels and Regional Television During the 1950s and 1960s

Sally Horrocks

Abstract: Over the past two decades scholars of science popularization have produced a wealth of research that examines the relationship between science and film, both documentaries and features, in the cinema and on television. Much of this research on science and the moving image has focused its attention on programs with an exclusively scientific focus, with relatively little attention given to other ways in which visual images of science were presented to a popular audience, through news items for example. My paper will address this issue by examining how science was presented to the public in the context of ‘news’ in 1950s and 1960s Britain. I will do this through an analysis of material from newsreels and from ATV, the regional independent television broadcaster for the English midlands established in the mid-1950s. I consider first the extent to which the specific demands of the two media and the different audiences they served led to differences in the balance between entertainment and information and in the style and focus of reports. Secondly I examine the way scientists were presented in both media as simultaneously ordinary and extraordinary, capable of solving important problems and of carrying out heroic feats in their search for knowledge, but also linking their work very firmly to everyday concerns. Finally I assess the extent to which the very positive image of science that dominated during the 1950s and early 1960s endured through to the end of my period.

A British Physicist in Peking: William Band's Career in China

Danian Hu

Abstract: William Band was a British theoretical physicist, who received his M.Sc. at the University of Liverpool in 1927. In 1929, he gave up a chance to study for his Ph.D. in the Cavendish Laboratory at Cambridge University as well as a lucrative job offer from the Imperial Chemical Industries; instead, he chose to accept the call from the physics department at Yenching University, a missionary school in Peking. In three years, Band became the head of the department which he led for a decade until the Japanese army shut down the university in December 1941. At Yenching University, Band not only established his career as a theoretical physicist but also made significant contributions to Chinese development in modern physics education and research, cultivating many distinguished Chinese physicists in the 20th century. Based on archival resources in both English and Chinese, I will explore in this paper Band's motives to relocate in Peking and discuss his transnational contributions to the study of theoretical physics in China, contributions that have thus far been largely overlooked.

Reading What Was Spoken: Classroom Notes in our Understanding of George Herbert Mead

Daniel R. Huebner

Abstract: George Herbert Mead is remembered as a foundational pragmatist and social theorist primarily through the medium of the posthumously published *Mind, Self, and Society*. The vast majority of references to Mead's work have been to this volume, and its largest influence has been in certain theoretical perspectives of sociology. Yet this work is constructed out of disparate students' and stenographers' notes from some of Mead's courses in a controversial attempt to "systematize" his teachings. As a result recent critical scholarship has sought to circumvent the view of Mead constructed in the appropriation of select parts of this book and to seek Mead's own intellectual development. In this paper I argue that taking seriously the classroom notes out of which *Mind, Self, and Society* was created challenges both the dominant interpretation of Mead based on selections from the published volume and the alternative attempts to discover a "definitive" systematic Mead. Instead, I utilize a substantial body of archival documents in order to demonstrate that these notes are evidence of unique extemporaneous speech practices. Understood as such, the notes expose the social process of the creation of ideas. In particular, both Mead and his students co-directed the course of lectures toward their scholarly interests, mutually intelligible examples, and hot topics of the day. And since the extant texts are mostly students' notes, comparison across the documents from the same course reveals how different individuals accounted the content of the lectures.

Hermann von Helmholtz and the Historicity of Musical Form

Alexandra E. Hui

Abstract: Hermann von Helmholtz earned early acclaim in his 1863 opus *On the Sensations of Tone as the Physiological Basis for the Theory of Music*. This text as well as Helmholtz's musical aesthetics, his musicianship, and his participation in the music world reveal that he understood sound in musical terms. For Helmholtz, music was a valid avenue through which to

approach and understand the sensation of sound; music and sound were treated as interchangeable scientific, investigative objects. Both had materiality and form. Further, his musical aesthetics and his practice of science can be understood as similarly classicist. In both realms Helmholtz was preoccupied with issues of form and universal laws, perhaps echoing the formalist listening goals articulated by Eduard Hanslick in his 1854 treatise, *The Beautiful in Music*. "Sonically moving forms" were, according to Hanslick, the essence of music and functioned to express musical ideas. Because form was both musical structure and musical content or idea, it both transcended and was specific to history. Common to both Hanslick's and Helmholtz's use of form is language of figuration and materiality. Ultimately, Helmholtz's classicist musical tastes as well as his deeply personal interaction with musical instruments allowed him to reconcile his conception of sound as physical object with his conception of sound as music. This paper examines Helmholtz's efforts to reconcile universal physiological theory of sound sensation with historically- and culturally-bound musical aesthetics and discuss how this reconciliation was tied to his conceptions of form.

Susana Soare's Diagnostic Objects

Matthew Hunter

Abstract: If bees visibly swarm toward your mouth, you have cancer. This is the diagnostic claim made in the "new organs of perception" designed by contemporary artist Susana Soares. Collaborating with a growing industry of "insect olfaction" researchers in British bio-technology, Soares creates multi-chambered glass objects engineered to the flight and swarming patterns of insects trained to detect specific chemical scents by Pavlovian reflex. Exhaling into Soares's hand-held, insect-filled vessels, a human patient can watch as the bees react, either remaining in the object's outer shell or flying into its inner chamber if their incredible sense of smell registers chemical signatures of cancer in the user's breath. My paper, first, places Soares's project in much longer, experimental traditions of making "new organs of perception" (a phrase she adopts from Francis Bacon), especially those traditions of early modern England. More broadly, I ask how we might use objects like these to think "visual evidence" at a triangulation between human vision, multi-sensorial animal perception, and the clinical techniques of medical visualization that Soares's objects replace—apparently with comparable diagnostic efficacy.

Biological Kinds and Moral Categories in American Regulation of Human Embryo Research

Ben Hurlbut

Abstract: This paper explores how notions of the fixity of the biological categories of "cell" and "organism" and notions of biological "potency" shaped approaches to moral deliberation and regulation of human embryo research in the United States. This paper examines some complications that emerged when this classification was applied to in vitro human embryos, particularly after the derivation of human embryonic stem cells. From the late 1990s forward, the ontological distinction between cell and organism as well as their respective potencies became a focus of vigorous disagreement, particularly in discussions of how to apply human subjects research regulations to human embryos. I examine several moments— in regulatory documents, in congressional debate and in public deliberation— where attempts were made to resolve

normative and regulatory problems around human embryo research by invoking these biological boundaries. I will show how designation of biological boundaries became central to ethical assessments of human embryonic stem cell research, particularly in relation to somatic cell nuclear transfer (cloning); and, further, how ontological uncertainties were used to challenge claims to moral certainty as ungrounded and thus unreasonable. I will argue that these ontological disagreements over the correct characterizations of biological entities were simultaneously disagreements over the forms of democracy necessary for producing reasonable public policy around technically complex objects. In other words, attempts to assimilate novel biological constructions to ontological categories were at once efforts to articulate the right relations between science, state and citizens: relations that could ostensibly produce morally unproblematic science together with reasoned democratic deliberation.

The Monitoring of Physical Well-Being in New Zealand before World War II

Kris Inwood

Abstract: Nineteenth-century New Zealand was widely, and correctly, recognized as a relatively healthy environment for Europeans and their descendants. The surprise discovery of high maternal mortality and significant numbers of men unfit for military service in WWI ignited concerns for physical well-being directed especially at the Maori population and the growth of children. In this paper I chronicle efforts in New Zealand to monitor the health of vulnerable groups. I examine the efforts to assess and understand physical well-being, especially for children, and I summarize what the available data tell us about stature and living standards for New Zealanders born in the first third of the 20th century.

Reconstruction of Physics in Postwar Japan and US-Japan Scientific Exchange

Kenji Ito

Abstract: This paper examines how scientific exchange and cooperation with the United States shaped reconstruction and development of physics in Japan after World War II. While historians debate over continuity and discontinuity of the history of science in Japan at the end of World War II, a drastic change in US-Japan relations in science was certainly a discontinuity. Not only did the Allied Occupation of Japan (1945-1952) bring significant reform in Japanese scientific research and governance, but also during the following several years, the relation with the United States had significant impact on the emergence of Japan's future vision about the relation between science and society there, and the vision of economic prosperity realized by advanced science and technology, in particular, by the Japanese counterpart of "Atoms for Peace." Some administrators of the Allied Occupation and several Japanese statesmen of science who collaborated during the occupation continued to be influential, and their efforts, as well as the mixed context of scientific cosmopolitanism and the Cold War politics resulted in scientific collaboration between the US and Japan in various areas, creating a framework of exchange of scientific personnel between the two countries. Nuclear and high-energy physicists who migrated to the United States using this framework formed a small but important group, who prepared development of high energy physics in Japan.

A Clockwork Bronze: The Calendar and "Olympiad Dial" on the Antikythera Mechanism

Paul A. Iversen

Abstract: In 1901, Greek sponge divers recovered from a shipwreck of circa 80-50 BCE a remarkable bronze device with gears now known as the Antikythera mechanism. Recently, a group of researchers has examined this badly corroded and brittle device with modern technologies that have revealed that the back of the device housed a Saros eclipse-prediction dial, as well as a Greek lunisolar calendar that was regulated according to the 235 months of the Metonic cycle and probably also the 76 years of the Callippic cycle. Furthermore, another dial was revealed to indicate the years in which some of the more important Panhellenic athletic games fell, including the famous Olympic games. The authors who published these results (Freeth, Jones, et al., Nature 2008), argued that the lunisolar calendar belonged to Corinth or one of its colonies, including Syracuse, and that this lunisolar calendar commenced one month after the autumnal equinox, or roughly October. This talk will demonstrate that the calendar is indeed that of Corinth or one of its colonies in NW Greece, that it cannot be that of Syracuse, and that the calendar's start date must be backed up two months to begin around August. It will also reveal a heretofore unidentified game in year 4 on the Game Dial and offer a new explanation of the four divisions of the Game Dial. All these new findings will have a significant impact on calibrating the starting time of the mechanism, and thus the date of the world's oldest known analogue computer.

Glassware Revolution: Chemical Glassblowing and the Material Culture of 19th-Century Chemistry

Catherine Jackson

Abstract: From the test tube to the conical flask, glassware provides chemistry with its dominant iconography. I show why chemists turned to glass and glassblowing and how, by changing chemistry's material culture, they transformed chemical practice. Chemists have chosen since ancient times to work in glass because of its transparency and chemical inertia, and because it could be shaped "in the flame of a proper lamp". Whilst glass was a widespread component of chemical apparatus made and used in élite centres including Paris, early 19th century chemists elsewhere – including Berzelius and Faraday – pioneered a new practice based on the use of home-blown glassware. They were partly motivated by the high cost and limited availability of traditional apparatus. But Berzelius and Faraday – both expert glassblowers – were also quick to appreciate the increased experimental control and flexibility gained by working in glass. Chemists with glassblowing skill turned with increasing confidence to glass to solve practical difficulties, as neatly exemplified by Liebig's creation of a new apparatus for organic analysis – the Kaliapparat. From the mid-century, specialist chemical glassblowers – foremost amongst them Heinrich Geissler – stood ready to realise and perfect chemists' prototype apparatus, creating standard items which supported the spread of new techniques through embodied experimental knowledge. Not only did specialists like Geissler help establish new techniques throughout the chemical community but their scientific expertise frequently allowed them to develop chemists' original ideas. Collaborations between glassblowing chemists and chemical glassblowers thus became important drivers of changing chemical practice.

Professionalism vs. Objectivity: Alternative Modes of Professionalization in Mid-Twentieth-Century America

Andew Jewett

Abstract: Although we possess an extensive array of studies revealing the social and cultural forces that have conditioned specific knowledge claims and the larger epistemological claim of value-neutrality, historians have tended in recent decades to exempt objectivity's opponents from their critical scrutiny. Here, I use the case of the United States in the 1930s to explore the social and cultural matrices that foster sustained challenges to objectivity within the natural and social sciences themselves. In the early 1930s, many professional scholars saw themselves as helping a new social order arise from the ashes of the old. By that decade's end, progressive scholars had come to view the struggle between democracy and totalitarianism as the encompassing context for their work. Looking across the 1930s, my paper traces the changing appeal of the philosopher John Dewey's "instrumentalism," a particularly prominent anti-objectivist epistemology, to professional researchers. The political climate of the late 1930s, no less than its predecessor, generated considerable discomfort with objectivity claims. But this discomfort now appeared among different groups of scientists and inclined them toward different alternatives to the prevailing discourse of objectivity. These patterns reveal the operation of professional interests among objectivity's critics, as well as among its defenders. Righteous outrage at the misuse of knowledge claims certainly drives the opponents of value-neutrality, but concrete considerations of power and position operate under the surface as well.

Rethinking the "Applications" of Quantum Mechanics

Christian Joas

Abstract: Many of the leading researchers in quantum theory maintained an interest in questions regarding the constitution and behavior of matter that they hoped would be resolved through the development of quantum mechanics, but for which the new theory, as formulated in the years 1925–7, provided no immediate solution. Among these lingering questions were the stability of molecules, the persistence of ferromagnetism, and the conductivity of metals. In 1928–1935, physicists presented solutions to these questions that contributed to and relied upon the development of a common stock of novel concepts and techniques appropriate to quantum mechanics for addressing what is known as the "many-body problem." Historians cite solutions to these problems as amongst the earliest successful applications of quantum mechanics, or, as Jammer put it, as "validations" of the new theory. At the same time, these same solutions appear individually in standard histories of an array of sub-disciplines of physics, including solid-state physics and quantum chemistry, often as cornerstones of those sub-disciplines. Both types of account have in common that they portray these researches as essentially subsequent to quantum mechanics, i.e., as "applications" in a distinctly subordinate sense. In our talk, we challenge this subordination and argue both that new techniques for addressing the many-body problem had roots that predated quantum mechanics and aided in its appropriation, and that these "applications" of quantum mechanics altered central aspects of how physicists conceived of and used quantum mechanics.

Recovering Natural History after World War I

Kristin Johnson

Abstract: This paper will examine the fate of natural history in the early twentieth century, in order to discuss the various avenues through which it has waged comebacks at various times and places. By focusing on naturalists and their journals in the United States and Britain during the period immediately following the First World War, one can study both what natural history has meant at particular times, and examine high-stake discussions over whether that meaning should change in the face of a profoundly changed world. These discussions included the balance between theory and description in the face of changing methodological emphases in biology more generally, the continued role – if any - of natural history collections, and the means by which naturalists would receive both financial support and professional prestige in the post-war world. Specifically, a comparison between British and American naturalists between 1918 and 1925 illustrates the tight links between the socio-economic shifts taking place in their respective countries, and the changing popularity and prestige conferred on naturalists and natural history. These changes influenced, in turn, the means and strategies whereby naturalists recreated their aims, methods, and institutions in an attempt to navigate their tradition safely through post-war changes.

Albert Rehm and the Antikythera Mechanism

Alexander Jones

Abstract: The discovery in 1902 of fragments of a bronze artifact bearing toothed wheels and Greek inscriptions among the objects recovered from a Hellenistic shipwreck off Antikythera aroused immediate excitement and debate among scholars in Greece but received practically no immediate attention abroad. In 1905 and 1906 Albert Rehm, a young German classical philologist and epigrapher, examined the fragments and developed a novel hypothesis that they derived from an ancient mechanical planetarium. Rehm's researches, which he resumed sporadically over the four subsequent decades (with Ernst Zinner as a collaborator at later stages), were never published. Adducing physical details as well as evidence from the inscriptions, Rehm anticipated many more recent interpretations of the mechanism's functions, but his work also reveals limitations on understanding it imposed by the conditions and resources of classical and archeological research in the early 20th century.

Staying Tuned: Representations of Resonance between Acoustics and Optics in the Late 19th Century

Marta Jordi

Abstract: The tuning fork was an essential model for the development of acoustics in the 19th century, principally due to Helmholtz and Rayleigh. When sound waves interacted with the fork, they excited its “natural frequency” through resonance, thus giving rise to the pitch. Sound waves and fork were covibrating. In the 1870s, physicists drew upon the same idea to explain optical dispersion, although light waves and sound waves were considered essentially different in nature. Eventually, the covibrations turned out to be a very fruitful tool to account for optical phenomena as a result of light waves interacting with moving particles of matter. However, the

covibrations were instantiated by different pictures of the light-matter interplay: a system of entangled pendulums carrying punctual masses of ether and matter (Sellmeier), a hydrodynamic system (Helmholtz), elastic theories of light (Voigt) and electromagnetic theories of light (Helmholtz, Lorentz). Indeed, Helmholtz used Hamiltonian dynamics procedures to embed the motion of particles into Maxwell equations and thus to reinterpret covibrations in electromagnetic terms. The specific nature of those matter particles was not important until the 1900s, when Drude incorporated the recently discovered electron into this model and connected it directly with the chemical theory of valence. In this paper I will analyze how the idea of covibrations was able to transmit knowledge across the divide between acoustics and optics, and how its assimilation through different abstraction methods led its physical interpretation become thicker and thicker, by connecting theories of light and matter, optics and chemistry.

"Voices of the People": The Royal Prussian Phonographic Commission and Germany's Prisoners of War, 1915-1918

Judy Kaplan

Abstract: The Royal Prussian Phonographic Commission was dedicated to collecting ethnographic recordings from Germany's prisoners of war during World War I. My paper details the history of this organization, exploring the significance of new field sites and recording technologies for the language sciences, as well as the transformative effect these technologies had on researchers' self-understanding as modern subjects and practitioners of science. Due to the war and the complex legacy of nineteenth-century colonialism, a broad range of non-European ethnicities came to be imprisoned in Germany. Anthropologists described the camps as fortuitous *Völkerschauen*: linguists in particular thrilled at the unprecedented access POW camps afforded to the literary memories, oral outputs, and physical speech processes of diverse human groups. Wilhelm Doegen (1877-1967), chief architect of the Commission, put more than 30 linguists to work, instructing them to collect language samples according to a strict protocol: Standard texts were to be documented in their original orthography, phonetic transcription, German translation, and recorded on wax cylinders or disk. These collections would form the basis of a novel "research station," the *Lautabteilung*, an archive devoted to the preservation and scientific study of some 215 "living" languages. My paper analyzes programmatic literature and correspondence in an effort to understand scientific and social interests underlying work of the Commission. I argue that new technologies applied to novel arrangements of human groups motivated linguists to accommodate the conception of living language to historical research priorities, contributing to a scientific conception of history as process.

The Excitations and Suppressions of the Times: Locating Emotional Disorders in the Liver in Modern Chinese Medicine

Eric Karchmer

Abstract: In contemporary China, "holism" is celebrated as one of the unique and characteristic features of Chinese medicine. Anthropologist, Zhang Yanhua, has provided an important example of this holism in practice, showing how contemporary doctors of Chinese medicine resolve emotional disorders by treating "constraint" in the liver. But when we look historically at these treatments for emotional disorders, we find them to be a surprisingly modern phenomenon,

shaped by the new flows of medical knowledge coming to China via Europe and Japan in the early 20th century. Zhu Danxi, the famous 14th century physician was the first individual to give prominence to the pathology of constraint, but he believed it was caused by external pathogens entering the body to obstruct its internal flows. It was not until the early 20th century that doctors decisively located the pathology of constraint in the liver and recognized internal causes, such as emotional volatility. This transformation in theory and practice was catalyzed by the encounter with biomedicine, particularly new knowledge about the nervous system and diseases such as neurasthenia, a very popular diagnosis in Japan at the time. Inspired by the revolutionary spirit of the times and a new empiricist ethic, reformist doctors argued that classical references to the liver were actually indexing the functional properties of the nervous system, and that nervous system excitation and relaxation could be modulated through treatments of the liver. Today's doctors continue these types of treatments but have forgotten their hybrid origins.

Psychiatry and the Visual Turn

Andreas Killen

Abstract: This paper explores recent interest among historians in psychiatry's visual archive, paying particular attention to relations between psychiatry and the medium of film. Recent scholarship has traced the ways that, from its inception as a medium of research and education, film was embraced by practitioners in the fields of neurology, psychiatry, and psychology as a means of documenting and recording the motor disturbances, epileptic convulsions, and hysteric fits of their patients. Motion pictures allowed clinical phenomena to be captured and studied with new precision, thus facilitating both research and instruction. Looking at scholarship in a number of areas, this paper situates this development within new interest in the larger history of techniques of "mechanical objectivity" and the privileging of visual forms of knowledge-formation as well as transfer, to both specialized and wider audiences. A few examples of recent scholarship will be discussed for their implications for the historiography of psychiatry: films on the diagnosis and treatment of World War I shellshock; and popular-scientific and enlightenment films on psychiatric themes ranging from psychoanalysis to mental hygiene and eugenic sterilization. Lastly, a handful of new research initiatives, including the online library and discussion forum Motion Pictures in the Human Sciences, will be briefly discussed.

Joseph Henry's Pure-Science Ideal: The Search for the Social Niche for Science in Antebellum America

Bongkook Kim

Abstract: This paper examines the pure-science ideal of Joseph Henry, the first secretary of the Smithsonian Institution. His conception looks like the "science discovers, technology applies" notion that has been criticized by historians of technology. It seems banal that he emphasized scientific discovery as a fundamental source of usefulness. It is familiar as a recurring narrative to justify the support of basic research. My aim in discussing Henry's ideas is to uncover its appearance similar to a universal statement and reveal its intended and actual meaning. To this end, the paper analyzes the social conditions from which his ideas emerged. In addition to the scientific community's historical circumstances, including the so-called Market Revolution, the Patent Act of 1836 as a reformed reward system, quantitative expansion of the scientific

community, and government patronage of science, I especially focus on Henry's scientific consulting activities, particularly for Samuel Morse and his rival telegraphic inventors. In the process of doing these activities, Henry concretized his ideas about science and its role in society: it takes some time to bear practical fruits of scientific discovery; science ought to avoid immediate applications; it should rather endeavor to become a disinterested arbiter capable of evaluating exactly the practicability of various technological projects, and this is the highest usefulness that could be expected from science. By giving these social roles to science, Henry tried to achieve his multi-layered goals: (1) establishing the authority of science, (2) enforcing the reformation of scientific community, (3) and drawing social support for science.

Seashore Natural History Networks of the 1850s: A Literary Perspective

Amy King

Abstract: I will present on the inter-textual networks among various so-called "popular" seashore naturalists of the 1850s, including Philip Henry Gosse, W.H. Harvey, Anne Pratt, Margaret Gatty, Isabella Gifford, and J.G. Wood. I will put these naturalists in conversation with George Eliot (in part through GH Lewes), whose emergent realism can be traced precisely to the same two to three year period when she accompanied Lewes at the seashore as he researched and prepared to write Seaside Studies. My emphasis here will be less on the interpersonal networks among these figures, and more on the textual networks that can be traced among the natural histories and between the natural histories and novelistic realism. I will focus on these naturalist texts' emphasis on quotidian subjects or the "commonplace" rather than the rare natural object, as well as their intense devotion to the detail, and think about these two qualities in relation to George Eliot's famous claim for realism, which she described in her realist manifesto (embedded in Adam Bede) as "the faithful representing of commonplace things." I suggest that the natural-theological underpinnings to much early-to-mid nineteenth century natural history is what drives the emphasis on the commonplace, and that literary realism is more connected to this genre, and thus more indebted to a non-secular epistemology, than we have generally argued. I will argue that the textual network that can be discerned among these figures is especially illuminating of the engaged relationship between putatively literary and putatively scientific texts.

Darwin on the Cutting Room Floor: Evolution, Film Censorship, and the Hays Code

David A. Kirby

Abstract: Movies represent the sum of decisions made by filmmakers during production. Sometimes, however, organizations and individuals external to the production process made determinations about what could and could not be included in a film. In particular, censor boards often dictated what scientific subjects were considered appropriate for films and which were considered indecent. This paper will utilize new work on the "cultural meanings of film censorship" to examine the historic censorship of evolutionary themes in American fiction films. By examining the negotiations between censors, the entertainment industry and filmmakers this paper reveals society's changing ideas about cinema's and science's role in influencing morality. Many early films ran afoul of censor boards for their inclusion of evolution and Darwinism. *Murders in the Rue Morgue* (1932), for example, was not shown or was edited in several states because some censor boards objected to the theme of "Man's descent from the Apes." I will also

examine how evolutionary themes fell victim to the notorious Motion Picture Production Code – commonly referred to as the "Hays Code"– of the Production Code Administration (PCA) Office that was in effect from 1934-1968. The code was established in large part due to the lobbying of religious organizations that were unhappy with the level of violence, sexual innuendo and amoral themes like evolution in movies. Films such *The Beast of Borneo* (1934) and *Dr. Renault's Secret* (1942) were modified before production or edited before release to play down their evolutionary themes in accordance with the PCA's recommendations.

To "Better Conceive the Exact Shape of This Wonderful Animal:" The Role of Pictures in Edward Tyson's Anatomical Descriptions

April Kiser

Abstract: The naturalist Edward Tyson prepared multiple illustrated anatomical descriptions, including the study of a chimpanzee specimen in *Orang-outang, or the Anatomy of a Pygmie* (1699). Dissection's power to open animal bodies and expose their internal mechanisms made it an important tool for Tyson in his quest to define the objects of nature. He found pictures an important tool in his study of animals, referencing those found in previous natural history volumes and including new images made during his own dissections. The pictures, he believed, aided readers in conceiving the exact shape of the animal. In the *Anatomy of a Pygmie,* Tyson offered eight foldout engravings of his dissected specimen to accompany his written description. My paper investigates Tyson's use of pictures to explore the internal spaces of animal bodies. He utilized images to study specimens and situate his personal observations within a dense body of existing natural history. Specifically, I explore Tyson's efforts to read the lively characters, which he believed revealed knowledge of God and humanity, inscribed in all animals. His anatomical studies illuminate the ways pictures made visible the mechanisms of animal bodies in an effort to determine each animal's place in the order of nature. Offering readers a glimpse into the hidden recesses of the body, Tyson used pictures to promote his hands-on investigations of animals. Moreover, he used the internal spaces to display the anatomical expertise that was essential to his new program of natural history.

Stunted Growth: Setting Scientific Standards for Children's Height

Aimee Klask

Abstract: The National Center for Health Statistics (NCHS) in a 1976 report suggested, "American children had stopped growing taller, thereby breaking a century-old trend of youngsters towering over their parents." During the last century, there was a one-half of one-inch increase in height every ten years, but in 1976 it looked as if this trend had "virtually ceased." Those close to the study wondered if Americans had reached their "genetic potential regarding growth" or if positive changes in nutrition, pure water, and vaccines attained their maximum contribution. The LA Times considered the ramifications of the end of this growing trend by wondering if "professional basketball scouts" will be able to recruit taller centers from the future crops of superstars. While speculation swirled around the future height of Americans, the NCHS announced the publication of fourteen new growth charts intended to serve as public health instruments and diagnostic tools for physicians to monitor the individual growth of children. Within a decade, while concerns over the height of the new generation of basketball players

subsided, the NCHS growth charts, a CDC version and subsequent World Health Organization adaptation of these charts became ubiquitous fixtures in doctors' offices across the nation and the world. This paper explores how these charts contributed to the global normalization of average measurements generated from the U.S., the standardization of measuring growth as a clinical practice, and provided an important platform for the selling of human growth hormone.

The Locality of Scientific Internationalism

Fabian de Kloe

Abstract: It is a longstanding trope that since the birth of modern science, scientists have peacefully collaborated while armies and nations were fighting. The reality of this image may well be questioned, but this does not make the internationalist rhetoric articulated by scientists less real. Historians of science have pointed at a diachronic shift of meaning of scientific internationalism over time. The Republic of Letters is not the same as the 1875 Meter Convention or the community of physicists at CERN. This paper explores the rhetoric of scientific internationalism synchronically by comparing two early 20th century conceptions of scientific internationalism. From 1901 onwards, the French logician and mathematician Louis Couturat (1868-1914) and the German chemist Wilhelm Ostwald (1853-1932) collaborated to promote a scientific international language called Ido. Through its supposed rational precision and neutrality, Ido was not only meant to facilitate the transfer of scientific knowledge; it was also an expression of the supranational character of science. Their effort to promote it as such suggests a smooth alignment of scientific internationalist ideals. However, Couturat and Ostwald each had their own motives to develop and promote Ido. These motives differed and were an expression of specific disciplinary, national, and personal circumstances, suggesting that the rhetoric of scientific internationalism takes different shapes within one period.

"A Fugitive among Industries": The Knowledge Dimension of Bengal Plantations

Prakash Kumar

Abstract: The process of early origins of indigo plantations in late eighteenth century colonial Bengal has been richly studied by historians of South Asia and yet our understanding of the subject remains partial. Most historians readily take the line that the "West Indian" system of indigo manufacturing from the Caribbean was "introduced" by European planters into the colony. This view inheres with the assumption that the knowledge of indigo production was developed elsewhere and that this fully formed knowledge was then "transferred" to the subcontinent. This paper makes the contention that a new framework focusing on diasporic movements and knowledge flows better explains the building of the plantation system in Bengal. This new framework focuses on a trail blazing production of indigo texts by philosophers in the island colonies of the Atlantic and their subsequent dissemination. It also dwells in the movement of planters and naturalists to show the multi-directionality of knowledge of indigo production in the era of plantations. The paper argues that the modern culture of indigo in reality developed at a number of sites in the Caribbean, Spanish Central America, South Carolina, and Bengal between the seventeenth and the nineteenth centuries. The West Indian indigo manufacturing was less a definitive knowledge "system" and more a stable form of practice that was amenable to alteration in new situations. A consideration of the regime of knowledge tied to

flows and movements is more suited to explaining the cumulative past of the indigo plantations in Bengal.

Helmholtz's Music – A Geometry of Tones

Julia Kursell

Abstract: In his book *On the Sensations of Tone as a Physiological Basis for the Theory of Music* (1863), Hermann von Helmholtz made a purposeful omission that is often overlooked. While he discriminated a physiological stratum of sensation from a psychological stratum of perception, he never argued that the activity in the latter consisted of forming musical tones out of the sensations. Rather, this psychological stratum provided knowledge about sound sources: it attributed a specific combination of sensations to a clarinet, another specific combination to the flute. Whereas the popular versions of his theory of hearing did talk about the fusion of sensations to musical tones, the long version in the book tried to avoid such a statement. My contribution will take this diagnosis as its point of departure and ask about the status of music in Helmholtz's physiological argument on the functioning of hearing. Already in the first edition of his book, he declared that music is an art of ordering sensations rather than psychological representations. In the fourth edition – the last to which he made changes in his lifetime – he added a passage that compared music to geometry. In my contribution I will discuss how this idea of music related to experimental sensory physiology, and whether and how the introduction of music as geometry changed this relation.

From the Arctic Seas to the Global Ocean: Soviet Oceanography from the Second IPY to the IGY

Julia Lajus

Abstract: This paper analyses how Arctic experiences during the 1930s provided the platform for the boom of Soviet oceanography after 1945, when the country began major oceanographic research around the world. The Second International Polar Year (1932-33) was crucially important. Although oceanography was not initially considered part of the Soviet program, a strong community of oceanographers took shape under diverse patronage as the Soviet Union sought to deploy their expertise in the Arctic. A research component was added to the cruises that supplied polar stations, and to cruises along the newly established Northern Sea Route. The Institute of Oceanology, founded after 1945, relied upon staff and experience from this formative period. A distinct field culture based on long-term multidisciplinary expeditions, with a diverse community of scientists from different institutions on board, of different ages and genders, arose in the Arctic. This became the foundation of Soviet oceanography in other latitudes – including the extension of Soviet oceanographic research to Antarctic waters during International Geophysical Year (1957-58). The paper concludes that Soviet oceanography moved from a small network of scientists searching for both international and national patronage to a state-based project that derived funding from its strategic and political importance.

Developing Consensus on Relativity in the USA: The Controversy about Miller's Ether-Drift Experiments

Roberto Lalli

Abstract: In 1925 Dayton C. Miller (1866-1941) claimed that his repetitions of the famous Michelson-Morley (MM) experiment had showed a non-null result. Some scientists, including Miller, interpreted this finding as a disproval of relativity theories. The subsequent controversy had a relevant role in the 1920s reception of relativity in the USA. The dispute lasted until the early 1930s, when the great majority of the scientific community had rejected Miller's results. It involved theoretical discussions about the interpretations of Miller's data, experimental repetitions of the MM experiment, and epistemological debates about the relationship between theories and experiments. All these factors played a very specific role in the resolution of the dispute, but the standard historiographical version gave a crucial significance only to the experimental side. This version stated that Miller's results were discarded because the following repetitions of the MM experiment did not show the same effect. However, this simplistic explanation does not analyze the different theoretical frameworks on which these experiments were conceived; it also hides the diverse types of contribution that led to the closure of the controversy, in the context of the accumulation of consensus on relativity. The aim of this paper is to delve into the mechanisms of the dispute in the local context of the US scientific community using a symmetrical approach, considering both parts of the controversy. Following this approach, it is possible to uncover the sociological factors as well as the epistemic roots that led to the eventual rejection of Miller's result in the USA.

Toxic Bodies: Endocrine Disruptors, Uncertainty, and Precaution

Nancy Langston

Abstract: This paper will examine the history of diethylstilbestrol (DES), the first synthetic estrogenic drug, and the first synthetic chemical to be identified as an endocrine disruptor. Beginning in the 1940s, millions of women were prescribed DES, first to treat menopause, and then to reduce the risk of miscarriage. By the 1950s, livestock were implanted with DES to promote rapid weight gain, and the metabolic byproducts of DES made their way from feedlots into broader ecosystems, exposing a wide range of wildlife to the hormonal effects of the chemical. Well before the Food and Drug Administration first approved DES in 1941, researchers understood that DES caused cancer and problems with sexual development in laboratory animals. These concerns initially led FDA Commissioner Walter Campbell to reject the drug, arguing that regulators must follow what he called the "conservative principle." FDA regulators essentially adopted the precautionary principle sixty years before that term came into common usage. Yet by 1947, the FDA had abandoned its position of precaution, telling critics of DES that it was up to them to prove that DES had caused harm, rather than up to the drug companies to show that DES was safe. American debates in the 1930s and 1940s over the regulation of DES show how political pressures, scientific uncertainty, and changing conceptual models of gender and health led to a retreat from precaution.

Mark A. Largent, Associate Professor, James Madison College of Public Affairs at Michigan State University, Director of the Science, Technology, Environment, and Public Policy Specialization

Mark A. Largent

Abstract: Mark A. Largent, whose training is in the history of science, has developed his career in the direction of public affairs and science policy, and he specializes in integrating the methods and habits of an historian to his work in public affairs. He recently finished a book-length manuscript on the modern American vaccine controversy and public concerns about a potential relationship between vaccines and autism. His projects employ the methods and approaches of an historian – which include narrative and a forthright effort at understanding the worldviews and concerns of each of the actors – to analyze a current or ongoing controversy that contains both scientific and socio-political elements. Largent is Associate Professor in James Madison College of Public Affairs and Director of Michigan State University's Science, Technology, Environment and Public Policy Specialization [STEPPS]. STEPPS is a cross-collegiate program that trains students in public policy that relates to science, technological development, and environmental science by integrating classes in science, science studies, and public affairs. STEPPS faculty members apply history and philosophy of science to improve how science policy professionals are trained and how science policy is made and implemented. They are also committed to outreach through their own work, and by training future public policy professionals. Largent has developed and directed STEPPS since 2005.

Edward J. Larson, University Professor of History and Hugh and Hazel Darling Chair in Law, Pepperdine University

Edward J. Larson

Abstract: Edward J. Larson holds the Hugh and Hazel Darling Chair in Law and is University Professor of History at Pepperdine University and recipient of the 1998 Pulitzer Prize in History. The author of eight books and over one hundred published articles, Larson writes about issues of science, medicine and law from an historical perspective. His books include *An Empire of Ice: Scott, Shackleton and the Heroic Age of Antarctic Science*; *A Magnificent Catastrophe: The Tumultuous Election of 1800* (2007); *Evolution: The Remarkable History of a Scientific Theory* (2005, 2006 rev. ed.); *Evolution's Workshop: God and Science in the Galapagos Islands* (2001), *Sex, Race, and Science: Eugenics in the Deep South* (1995), *Trial and Error: The American Controversy Over Creation and Evolution* (1985, 2003 rev. ed.) and the Pulitzer Prize-winning *Summer for the Gods: The Scopes Trial and America's Continuing Debate Over Science and Religion* (1997). Larson's articles have appeared in such varied journals as *Nature, Atlantic Monthly, Time, Isis, Science, Scientific American, The Nation, The Wilson Quarterly, American History, Virginia Law Review, and Constitutional Commentary*. The Fulbright Program named Larson to the John Adams Chair in American Studies for 2001. He participated in the National Science Foundation's 2003 Antarctic Artists and Writers Program. Larson has delivered invited addresses at over 80 universities and is interviewed frequently for broadcast and print media, including multiple appearances on PBS, NPR, the History Channel, C-SPAN, and BBC.

Authentication, "Empirical" Practice (Shiyan), and Anxiety about Fake Things and False Words in 1930s' Chinese Technical Manuals

Eugenia Lean

Abstract: In an era of vibrant capitalism and burgeoning mass media, 1930s China was not only characterized by an explosion of mass-produced things and mechanically-reproduced texts, it was also marked by increasing anxiety about inauthentic knowledge, counterfeit goods, and pirated words. Accompanying the flow of "legitimate" commodities and objects, a shadow economy arose in the industrializing urban centers of Republican China of untrustworthy items, sub-quality medicinal items, as well as pirated and foreign goods. With an increasingly sensational mass media and a highly commercialized marketplace of ideas, skepticism abounded about what sources of information were trustworthy, and concern about illicit words and misleading information was rampant. By examining a 1930s series of domestic and industrial knowledge, this paper explores how this era was marked by an increasing sense of ambivalence regarding the impact of industrialization, capitalism, and the mechanical reproduction of words and knowledge. To authenticate knowledge about industrial objects, these texts promoted a notion of verifying through practice and testing (*shiyan*), and identified the text's reader-practitioners of shiyan as the ultimate guarantors. Such an emphasis on hands-on verification echoed the endeavors of practical editing and compilation that the editor used to legitimate and authenticate the series itself and the production knowledge it sought to promote. In an era of perilous markets, false knowledge, and questionable science, this series and its emphasis on empirical verification offered strategies with which to give order to abundant materiality and dizzying textual profusion.

Public Good and Profit Margins: Lighthouses after the Fresnel Lens

Theresa Levitt

Abstract: France touted the Fresnel lens, which vastly improved the efficacy of lighthouses, as one of their "least contested claims to the recognition of civilized peoples." The lens saved lives, a testament to the Enlightenment ideal of knowledge improving the world. But it also saved cargo, and humanitarian impulses quickly mixed with economic self-interest in the lens' expansion around the world. Along the way, it transformed the very definition of a public good. When John Stuart Mill held up lighthouses as the best possible example of a public good, he did so in the wake of the England's recent decision to install Fresnel lenses in all of their lights. The lenses were hugely expensive and difficult to make, and none of the privately owned lighthouses that made a profit from light-dues ever bothered to buy one. Indeed, they shared many of the attributes of the luxury market, including glass from the royal manufactory Saint Gobain, best known for providing mirrors to Versailles. Now, however, France presented them as a gift from the state to the benefit of all of humanity. This paper examines this interplay of self-interest and the general good in the development of the Fresnel lens in France in the 1820s and its subsequent implementation.

Before the X-Club: the Queenswood-Marburg Network

Bernard Lightman

Abstract: Founded in 1864, the X-Club was an important dining club whose members included T. H. Huxley, John Tyndall, Joseph Hooker, Thomas Hirst, Edward Frankland, George Busk, John Lubbock, Herbert Spencer, and William Spottiswoode. They sought to redefine British science, which involved turning it into a professional, merit-based, publicly respected, and state-endowed activity. The X-Club was one of the most influential British scientific networks of the second half of the nineteenth century. Three members--Tyndall, Hirst, and Frankland--formed their own network before joining the X-Club. Tyndall arrived at Queenwood College, Stockbridge, Hampshire, in August of 1847, to teach mathematics and surveying. Edward Frankland began teaching chemistry there a month later. Becoming fast friends, they agreed that Tyndall would instruct Frankland in math and Frankland would teach Tyndall chemistry. Since Queenwood was one of the first schools in England to have a laboratory for the teaching of science, it was the ideal location for conducting research. In October 1848 both of them went to Marburg University in Germany, where they obtained doctoral degrees in science. Hirst, who had been friends with Tyndall before he went to Queenwood, followed them to Marburg in 1850 to study mathematics. After finishing his PhD in 1852, he took a position at Queenwood in the middle of 1853. I will argue that the Queenwood-Marburg Network had an important impact on the X-Club and evolutionary naturalism in general through their love of German science, German idealism, and laboratory research.

Before the Gene: LeRoy Matthews and the Cleveland Comprehensive Treatment Program, 1957-1961

Susan Lindee

Abstract: In only three years, 1957-1960, the Cleveland Comprehensive Treatment Program for Cystic Fibrosis reduced annual mortality from 10 percent to 2 percent in CF patients being treated there. In 1961, the protocol was introduced in Cystic Fibrosis Foundation Centers nationwide and mortality began to fall nationally; it in still used, in modified form. The primary architect of this complex therapeutic protocol was the physician LeRoy Matthews, a former radiation safety officer who worked with the Pacific bomb tests, and who also worked with the Atomic Bomb Casualty Commission in Japan. Lung failure is the most important cause of death in CF patients and Matthews attributed some of his insights to his understanding of how radioactive materials moved through the lungs. In this paper, I explore his work, life, and key role in the clinical innovations at the Cleveland Cystic Fibrosis Center, which is now named after him (as is a major prize in CF research). I place this story in the broader context of post-war human genetics. Today cystic fibrosis has more Medline citations than any other monogenic disease. But it was not widely studied by geneticists until the 1980s, and interest began to peak only after Francis Collins identified the gene in 1989. Essentially, CF was a pediatric disease for much of its history. My paper considers the story of clinical management of CF in this context, exploring how both the legacy of eugenics, and the potential of molecular genetics, shaped the scientific and medical interpretation of CF.

When Savants and the State Collide: Revisiting Dolomieu's Imprisonment and the "Triumph" of Cosmopolitan Science during the French Revolution and the Napoleonic Wars

Elise Lipkowitz

Abstract: This paper reconsiders the story of the imprisonment and release of the French geologist Deodat de Dolomieu, a story often recounted as an example of the ability of cosmopolitan science to transcend war and nationalism in the Revolutionary era. By revisiting the story of Dolomieu's imprisonment and placing it in the context of the larger phenomenon of savants being seized or detained during that conflict and in its geopolitical context, it calls into question the longstanding belief that savants' claims about their status as savants and the machinations of Europe' scientific societies were sufficient to secure their release. Instead, it calls attention to the ways that the stories of seized savants paralleled those of many other prisoners and the limits of the cosmopolitan scientific community in convincing European states to release imprisoned savants.

Whither Narcissism? Types and Traits in the History of the Personality Disorders

Elizabeth Lunbeck

Abstract: Researchers and clinicians preparing the fifth edition of psychiatry's Diagnostic and Statistical Manual of Mental Disorders, to be published in 2013, have proposed eliminating Narcissistic Personality Disorder from it, igniting a small firestorm of debate and controversy. The diagnosis was delineated to capture pathology that is now widely recognized—in the professional literature, in the literature of management and the workplace, and in shelves of self-help manuals. Over the last 50 years, it has figured at the center of any number of critical condemnations of the nation's sorry state; it has, among psychiatric categories, unmatched cultural purchase. In this paper, I examine what is at stake in psychiatry's repudiation of such a popular and resonant category and in its substitution of a well-recognized type with a checklist of personality traits. I look at what might be lost in this move, in particular focusing on the recent surge of writing on the narcissism of the powerful. And I raise the issue of the discipline's scientism, evident in its repudiation of this familiar, coherent, and, by many accounts, eminently useful diagnosis.

The Hanford Nuclear Reservation (1943-1987): a Case Study of the Interface between Physics and Biology during the Cold War

Daniele Macuglia

Abstract: The Cold War gives us many opportunities to delve into the interface between physics and biology during the 20th century. In addition to the well-known Chernobyl disaster in 1986, biological consequences of nuclear physics were also significant in the US example of the Hanford Nuclear Reservation, a plutonium production complex located in Washington State. During its active period (1943-1987), the Hanford Site shaped the history of US military nuclear research, constituting an important case-study for scientific-historical investigations. Although supposed to counter the Soviet Union's nuclear weapons and military programs during the Cold

War, the remarkable biological consequences of the research carried out in the facility ended up overshadowing its original political purpose. The high-level of radioactive waste harmed thousands of people living in the area, causing relevant environmental disasters which make the site the most contaminated area in the US even today. Nuclear research is uniquely dangerous since radiation can cause severe consequences both in terms of lives injured and environmental damage. I will address various ways in which nuclear physics and biology were used and abused at the Hanford Site to combine the needs of politics with the needs of a healthy society – topic that has strong resonances in our current days, as we can see in the case of the Fukushima Power Plant. This paper will further investigate the moral responsibility of science to society and the way in which biological research informed nuclear physics about the deleterious consequences of radiation on environment and on the human body.

Jane Maienschein, Regents' Professor, President's Professor, Parents Association Professor, and Director, Center for Biology and Society, Arizona State University
Jane Maienschein

Abstract: Dr. Jane Maienschein specializes in the history and philosophy of biology and the way that biology, bioethics, and biopolicy play out in society. Focusing on research in embryology, genetics, and cytology, Dr. Maienschein combines detailed analysis of epistemological standards, theories, laboratory practices and experimental approaches with the study of people, institutions, and changing social, political, and legal context in which science thrives. Her work has concentrated on embryo and stem cell research and she has written Whose View of Life? Embryos, Cloning, and Stem Cells (2003), which was a finalist for the Independent Publishers Award. She is Regents' Professor, President's Professor, and Parents Association Professor with the Center for Biology and Society in the School of Life Sciences at Arizona State University. Dr. Maienscheim is committed to public education about biology and its human dimensions and she has experience in the making of science policy as well as in educating future science policy professors.

The Material Culture of Asylums
Benoit Majerus

Abstract: Focusing on everyday objects of nineteenth- and twentieth-century asylums, this paper makes the case for greater integration of the material culture of asylums into the historiography of psychiatry. In particular, I examine theoretical texts in journals and textbooks, buildings plans, and patient records of several Belgian asylums to demonstrate the ways in which the very materiality of items such as doors, beds, and windows have deeply structured and transformed psychiatric practice. At the same time, the functions of these objects have themselves been redefined through the particular contexts of the psychiatric applications in which they have been used. Adopting a material culture perspective and an interest in the daily use of concrete things represents a change in the focus of historiography, away from psychiatrists toward other actors, such as patients, nurses, and caretakers. Moreover, reading the "biography" of objects reveals an interesting tension between the "imagined object" and the "used object." Indeed, most psychiatric objects have at least a triple life. First they are imagined by physicians, architects, and others. In a second step, they are fabricated by engineers and craftsmen. And finally they are

used by nurses, patients, and physicians. These processes contribute to a permanent transformation and redefinition: the functionality of an object is never a given.

A New Science and its Social Significance

Marjorie C. Malley

Abstract: Radioactivity burst into the world without warning. Nothing in late nineteenth-century science could have predicted it. Barely noticed at first, the new field exploded into view after the Curies' discoveries of new elements. Radioactivity's allure intensified after 1900 when its invisible rays showed promise as a cure for the era's most dreaded scourge, cancer. Radioactivity rapidly developed into a major research field, with its own professional journals, research centers, methods, measurement standards, and institutions. By the outbreak of World War I the field had matured. It had also reached an impasse in theory. New theories and discoveries led to the demise of radioactivity as a separate research area in the late 1920s. The field's meteoric rise, followed by its rapid transformation and absorption into the new areas of nuclear physics, nuclear chemistry, and particle physics, depended on a convergence of several factors. During its unusual and brief lifetime, radioactivity changed not only physics, chemistry, and other scientific fields, but also society and culture. This presentation will examine reasons for radioactivity's unusual disciplinary trajectory and some cultural and social effects it produced at the time, with special reference to Marie Curie's role in these developments. It will then consider some implications for the history of science and the ongoing human quest to understand ourselves and the world.

Designing the Horse: Painting and Breeding the Perfect Animal in Early Modern Europe

Daniel Margocsy

Abstract: Historians of scientific illustrations have long discussed how architectural plans and machine drawings served as projective blueprints for designing laboratories, ships and mathematical instruments. The images of natural history, in contrast, are usually taken to be purely descriptive, providing a more or less accurate representation of the plants, animals, minerals and humans of the Earth. In this paper, I dismantle this dichotomy through the study of the relationship between hippological imagery and early modern horse breeding. Throughout the sixteenth and seventeenth centuries, aristocrats, royalty, and even natural philosophers such as John Dee, imported Spanish jennets, Neapolitan, Barb and Arabian stallions to Northern Europe to create vigorous and aesthetically appealing breeds. Contemporary authors, such as Gervase Markham, Sir Thomas Blundeville and Nicholas Morgan, proffered many theories how to improve the horse races of England. In this talk, I examine how the renowned Renaissance artists' highly idealized images of horses, e.g. Giulio Romano's series in the Palazzo del Te in Mantova and Hans Sebald Beham's Proportions of the Horse, mirror the discourses of hippological treatises, and provide a visual, and even geometrical, model for designing the perfect breed. This paper thus shows how zoological images were not always descriptive, but could also serve as blueprints for breeders, actively shaping reality. As an iconographic study, it reveals how the same, idealized images of horses circulated between the distinct socio-professional groups of artists and breeders, and their aristocratic patrons.

You Too Can See What Galileo Did!

Allison Marsh

Abstract: In 2009 the International Astronomical Union coordinated International Year of Astronomy (IYA2009), which celebrated astronomy's contributions to society and culture, and aimed to stimulate worldwide interest, especially among young people, in science. To enable more people to have access to telescopes, the American Astronomical Society developed the Galeileoscope, an inexpensive, easy-to-use refractor. The Galileoscope was marketed to "classroom teachers, planetarium presenters, astronomy-club members, and anyone else eager to share the treats of the telescopic sky with others." Advertisements claimed that it was much more than a telescope; in fact, it was a "strategic initiative math, science, and technology literacy worldwide." The Galileoscope was also a tool to recreate history, allowing users to replicate the observations Galileo made of the moons of Jupiter in 1609. In the fall of 2010, I incorporated the Galileoscopes into a "History Lab" for my introductory survey, Science and Technology in World History. For one week everyone made nightly observations using Galileoscopes, while also reading *The Starry Messenger*. My goal was for the students to better understand the challenges Galileo faced in the collection of data and dissemination of his analysis. Some of my more surprising outcomes were students remarking with seemingly obvious observations, such as "Did you know that the moon isn't out all night long!" In this paper I will report on the success of this undergraduate experiment and will evaluate the benefits of using tools such as the Galileoscope to teach the history of science in a college classroom.

Fundamental Disputations: How Philosophical Debates Structured Solid State Physics

Joseph D. Martin

Abstract: A philosophical debate between particle physicists and solid state physicists roiled as these sub-disciplines grew through the second half of the twentieth century. Representatives of each contested the nature of "fundamental" research. The particle physics community adopted a reductionist approach, arguing that the fundamental laws were those governing the smallest constituents of matter and energy. Solid state physicists, in contrast, stressed the importance of higher-level characteristics, maintaining that investigations at many levels of complexity might yield fundamental insight. This talk traces the development of this philosophical disagreement, which grew both from specific problems physicists encountered while building their discipline, and from the demands of funding their research in Cold War America. Through an exploration of how physicists developed philosophical positions within an institutional context and deployed those positions in their rhetoric, I argue that philosophical considerations guided solid state physics' establishment and growth. This talk challenges the conventional wisdom that locates the quest for fundamental knowledge within the search for the elementary constituents of matter and energy. It further argues that philosophical considerations deserve a broader hearing from historians studying the institutional structure of science. The American physics community was engaged in sophisticated and generative disagreement over what types of physical knowledge could be considered fundamental. The centrality of this disagreement to the identity of solid state physics in the Cold War United States shows that the very process of defining fundamentality was just as important to the development of American physics as the search for fundamental knowledge itself.

The Americanization of Physics in Mexico (1935-1955)

Gisela Mateos

Abstract: This paper is part of an ongoing research on the history of Physics at the National Autonomous University of Mexico (UNAM) from 1935-1955. I want to argue that there was a process of americanization of the physicists and this benefited them for establishing the first Physics Community at the UNAM and in Mexico. Although the physicists were a small group they were related to the Mexican government and the design of t science and education policies. Since the 30´s the United States was involved in the construction of Science in Mexico. The origins of the professionalization of Physics at the UNAM is related to the grants and fellowships that were given by the American philanthropic foundations and the American Government to students during the 1930's, 40´s, and 50´s. A Van de Graaff generator was purchased to the High Voltage Engeneering Corporation for the UNAM in 1950. This acquisition was part of the "nuclearization" and "modernization" discourse of the Mexican Government. The research agenda of the Physics Institute before 1950 did not include nuclear experimental physics, so the sudden acquisition of the Generator reshaped the research projects so a new program had to be designed and technicians prepared. They were sent to MIT with William Buechner so they could learn how to use the instrument. Specifically with the use of the Van de Graaff the Physics Institute was consolidated.

Cohn as Darwinian? Concepts of Speciation and Monomorphism in Nineteenth-Century German Bacteriology

Christina Matta

Abstract: In 1872, botanist Ferdinand Cohn proposed creating a taxonomic system for bacteria that would use physiology as a means of bringing order to the jumble of species names then in use. In his system, Cohn relied heavily upon the conviction that bacteria are monomorphic organisms – that is, that they form distinct, individual species with their own stable form and physiological properties. This conviction ran contrary to earlier arguments that regarded bacteria as a single species with multiple forms. Historians of biology and medicine have usually contextualized the debate about monomorphism vs. pleomorphism within practical medicine – germ theories that identified specific causes could not be valid if bacteria were one, monomorphic species, for example – but my research explores the extent to which Cohn's own discussions of the stability of bacterial species reflect Darwin's discussion of speciation, then places this comparison within broader debates about mono- vs. pleomorphism among other German botanist-bacteriologists, such as Carl von Nägeli. Given Cohn's correspondence with Darwin and his acceptance of evolution through natural selection, re-examining his stance on pleomorphism may also add a new dimension to the study of Darwin's reception in Germany.

Bob Guccione's Scientific Americans

W. Patrick McCray

Abstract: By 1980, *Omni* magazine, published by porn king Bob Guccione, had become one of

the most popular science magazines in the U.S. Using essays, art, and fiction, *Omni* presented a sense of the future to its readers interested in a whole gamut of contemporary science - from cutting edge physics to the frontiers of bio-medicine to the paranormal. In its politics and advertising base, *Omni* provided bridge between the "hippie consumerism" of the Whole Earth Catalog and the "cyber-cool" of magazines like *Wired* and *Mondo 2000*. In this talk, I'll explore how *Omni* provided a space where borders and boundaries between mainstream and fringe and science and the occult were broached and blended. Building on the recent "popular turn" in the history of science, we'll see how *Omni* brought a range of scientists into contact with broader publics and helped transmit, translate, and sometimes transmute scientific knowledge.

Food or Drug? Conflicting Social Meanings for a Diet to Prevent Mental Retardation, 1953 to c. 1980

Donna A. Messner

Abstract: The 1934 discovery of the neurologically toxic metabolic disorder called phenylketonuria (PKU) was hailed as a breakthrough. For the first time, psychiatrists and pediatricians were presented with a form of mental deficiency attributable to an inherited inability to metabolize protein properly. Crucially, it was a form of mental deficiency amenable to treatment or prevention through dietary modification. However, the apparently simple solution to the problem, a diet low in a certain essential amino acid, turned out not to be so simple to integrate into the daily lives of people with PKU. The recipient of the diet was very much configured as a "patient" or "experimental subject"; someone under a physician's care who was expected to ingest an unpalatable material in a prescribed manner as part of a rigid dietary regimen. Meanwhile, these "patients" were children embedded in societal and familial food cultures. This paper will explore the ways in which the configuration of the product as "drug" in the clinic was incompatible with the lived reality of the patient at home, where social context created an alternative construction of the same product as a barely tolerable "food." It will show how physicians and dieticians enrolled families—-mothers in particular-—to master techniques to prepare and administer the regimen at home, thus medicalizing the idealized space of the family dinner table. In turn, many mothers rejected this medicalization, even as they embraced the special dietary needs of their children, seeking ways to domesticate and normalize the therapy.

Pragmatic and Multidisciplinary Research on the Prevention of Substance Abuse

Grischa Metlay

Abstract: This talk focuses on two areas of substance abuse prevention research that matured during the 1980s: drinking and driving and the transmission of HIV/AIDS. The former bolstered Reagan's alcohol control policies, while the latter discredited the President's drug control policies. I argue that both areas utilized similar forms of multidisciplinary relationships. In the late 1970s, federal public health policies prioritized "health promotion." The National Institute on Alcohol Abuse and Alcoholism (NIAAA) and the National Institute on Drug Abuse (NIDA) – the primary funding sources for American alcohol and drug experts – responded by funding research on how to prevent drinking and driving and the spread of HIV through intravenous drug use. Drinking and driving research included epidemiological and policy studies on alcohol-

related traffic fatalities, physiological experiments on blood-alcohol concentrations and cognition, and evaluation research on training programs for bartenders. HIV/AIDS research combined epidemiological studies on infection rates among intravenous drug users, ethnographic investigations of drug-using rituals, virological experiments on sterilization techniques, and evaluation research on needle sterilization and exchange programs. Drinking and driving research was mobilized in support of restrictive minimum drinking age and driving while intoxicated laws, while critics of Reagan's "zero tolerance" drug abuse policies used HIV/AIDS research to lobby for needle exchange programs. Despite falling on opposite sides of presidential policies, both programs involved similarly pragmatic approaches to multidisciplinary research: They were organized around questions that were directly relevant to the performance of targeted interventions, and both led to the development of interventions that were demonstrably effective.

Disputed Domains: Controversies over Ferromagnetism 1930-1952

Charles Midwinter

Abstract: By the early 1930's quantum mechanics was being brought to bear on a wide range of phenomena. With an accurate theory of the atom, some physicists felt it was only a matter of time before ponderable matter could be modeled from the ground up, its properties illuminated in the process. But many-particle systems often proved unpliable when set upon with the same tools that had explained spectra. Ferromagnetism was an especially recalcitrant case. The controversy that emerged around it reveals how new techniques developed to deal with many-particle systems carried with them not only calculational potential, but also important and divisive conceptual content. Two distinct theoretical approaches to ferromagnetism had emerged by 1940. The first, championed by E. C. Stoner and John Slater, was based on "itinerant" electrons. The second, led by John Van Vleck, modeled localized electrons under direct exchange. Although Stoner's theory was in much better agreement with existing data, physicists were still sharply divided over its legitimacy. In 1952, at a meeting in Washington, proponents of these two approaches clashed. Their arguments reveal what major players saw as the benefits and limitations of each approach. They also shed light on a larger debate within the community over the proper use of approximations. I will discuss this controversy, and how the arguments leveled by Van Vleck, Slater, and others reflected a more general tension in the growing field of solid state physics.

Aggression and the Public Science of Human Nature

Erika L. Milam

Abstract: From the mid-1960s to the mid-1970s, Americans imported from Europe scientific theories that defined human behavior in terms of animal instincts. Magazine articles discussing the innate aggressive tendencies of humans – by Desmond Morris, Konrad Lorenz, Lionel Tiger, Robin Fox, and Elaine Morgan, among others – were published in venues as diverse as Scientific American, the short-lived counter-cultural magazine *Fact*, and *Playboy*. These popular scientific depictions of human nature resonated strongly with images of aggressive, self-reliant men that flooded movie theaters. Stripped of the civilization that usually protected them from the harsh reality of bare existence, the heroes of New Hollywood films used every means possible to

survive the emotional and physical brutality of primitive life. Sam Peckinpah's *Straw Dogs* and Don Siegel's *Dirty Harry* (both released in 1971), for example, embodied social concerns that the causes and answers to violent behavior could not be located in any given cultural or legal system — the domain of the social sciences — but must instead be found in the biological constitution of individuals. The primitive lurked inside each one of us. Evolutionary biologists and historians of biology frequently return to the mid-1970s in their citations and see this period as crucial to the newfound authority of biologists to speak on human nature. Such attention has obscured the fundamental importance of these earlier public scientific conversations about zoological and anthropological research in changing theories of what it meant to be human.

Gaming Science

Colin Milburn

Abstract: Putting the field of game studies into conversation with the history of science, this paper will focus on the recent scientific practice of using videogame technologies to generate new experimental knowledge. Not only are videogame systems now creating the conditions for novel approaches to experiments inside real, physical laboratories, but they are also expanding conventional laboratory boundaries into global cyberspace, incorporating increasingly vast populations of researchers. As techniques of crowd-sourcing and computational networking become more and more facilitated by videogame systems and ludic practices, laboratory research now also comes to engage thousands of nonscientists as participants in the experimental systems. Indeed, videogame players from all around the world are being enrolled as researchers in actual scientific projects, in some cases even included as co-authors of the resulting scientific publications. I will examine the phenomenon of "massively-multiplayer laboratories" by turning to three specific case studies: 1) the collaboration between Stanford University and Sony on the Playstation "Folding@Home" project, now called "Life with Playstation"; 2) The Foldit protein-folding game that crowd-sources skilled gamers from around the world to predict the 3D-structure of newly engineered proteins; and 3) the scientific experiments taking place in the virtual world of Second Life. These three case studies help to show the extent to which videogames today participate in the unbounding of what counts as a laboratory and who counts as a scientist. Instantiating "democratic science" or "citizen science," these forms of scientific experiments, which are also massively-multiplayer games, intersect with ongoing debates over expertise, public engagement, and participatory science in the 21st century.

The Rurik Expedition: Cycles of Accumulation in Russian Overseas Exploration, 1815-1818

Albert Miller

Abstract: This paper examines the crew and journey of the Russian brig Rurik, the second successful Russian circumnavigation of the globe. Influenced by Bruno Latour's model of an ideal cycle of accumulation, this paper explores the disparate network of scientific data that was created during this voyage of exploration into the Pacific Ocean. It also attempts to explain why such a diffuse network could and would develop within the context of the Russian Empire, whereas in other contemporary overseas empires scientific data was often obsessively controlled by metropolitan political, military, and scientific institutions. Ultimately, examining this

expedition reveals not only how science was practiced and valued within the Russian Empire at the beginning of the nineteenth century, but also characteristics of the empire itself.

Somewhere Between Light and Shadow: Alfred Russel Wallace, Spirit Photography and the Trial of Henry Slade

Benjamin Mitchell

Abstract: Despite how it may seem to modern commentators, in London, at the end of the nineteenth century, the juxtaposition of the occult and the scientific was enough to challenge the epistemological framework of the naturalistic worldview fought for by professionals such as Thomas Henry Huxley and John Tyndall. More dramatically than this, it brought the black sheep of evolution, Alfred Russel Wallace, into court to defend the medium Henry Slade from the charges of his fellow scientist, the zoologist Edwin Ray Lankester. While the "deception" of slate writing was the occasion of the trial, the larger battle was fought over the definition of science itself. In particular it complicated the notion of what Lorraine Daston and Peter Gallison have termed "mechanical objectivity", and offered in its place a scientific understanding of the world that valued stability of characteristics over mechanical reproduction, observer interaction with phenomenon over passive observation and possessed a different understanding of the role of experts and amateurs in the production of knowledge. In looking at two attempts to produce a "crucial experiment" of the tenets of spiritualism we see that Lankester hoped, in the trial of Slade, to demonstrate the falsity of all spiritualist claims; while Wallace, acknowledging the kind of human weaknesses pointed to in the trial, instead looked to the evidence of spirit photographs.

Puny and Pudgy Privates: Measuring Draftees in WWII

Rachel Louise Moran

Abstract: By the end of WWII, media outlets had created public anxiety over the "soft" American man. The anxiety appears a direct result of Selective Service rejections of draftees, which peaked at an astonishing fifty percent. Director of the Selective Service, Lewis Hershey, spoke of a nation of "half-men," and plans for prehabilitation programs, Universal Military Training, and physical fitness councils began. This outcry was the result of increasingly prominent standards for soldier physique. Issues of height and weight only disqualified a small percentage of soldiers – less than two percent of rejections owed directly to concerns in these arenas. In part this owes to decreased standards for draftees compared to volunteers, with minimum heights dropped from 5'4 to 5'0 and weights from 120lbs to 105lbs to accommodate draftees. In time the low standards were spread to volunteers as well. The rejections that did occur, even after the amended standards, prove fascinating. Local boards typically rejected far more "overweight" than "underweight" individuals, even after receiving word from the Selective Service itself to opt for common sense over standards when in doubt. Yet national boards rejected far more "underweight" soldiers, and then chided local boards for their leniency. I use archival records and news articles to argue that in WWII standards came to dominant military thought about soldier fitness. Even then, however, actual adherence to accepted standards varied, as pressures both to fudge numbers to increase recruitment and to stay wed to standards from above made for confused local-level physicians.

What Does Money Mean? Monetary Exchanges in Postwar Research with Human Subjects

Jill Morawski

Abstract: During the past century, researchers in the biomedical and social sciences have commonly given money to people they study. Despite the economic, scientific, and moral implications of the presence and circulation of money through research relationships between investigator and subject, the history of these practices remain largely unexamined. This paper explores the history of monetary exchanges in research, and asks: What has money meant – to researchers and subjects? To pursue answers, we study psychologists' responses to a survey on ethical problems in research, which was conducted in the late 1960s and offers a wide look at contemporary practices. Using these accounts of practices, we following money as it made its way from researchers to subjects during post-World War II period when U.S. federal funding for science research skyrocketed. An examination of the history of monetary exchange reveals that three prominent understandings of money emerged after 1940: as an incentive to participate (recruitment); a living stipend (wage); and a variable (research design). The paper traces these three tropes and their reliance on particular, yet shifting, meanings of money for research subjects. Following the money also shows material and symbolic entanglements in investigators' logics: at times economics comes to be taken as psychology (or the moral) and at other times psychology (or the moral) is taken as economics. Our historical accounting of monetary exchanges in medical and psychological research aims to expand the history of quantification and of standardization during the twentieth century.

Ancient Greek Luni-Solar Calendars

John D. Morgan

Abstract: As in most other ancient cultures and even some modern ones (e.g., Israel and China), the ancient Greeks used lunisolar calendars in which the months of their civil calendars were supposed to track closely the phases of the moon, and occasionally a 13th month had to be inserted to prevent the months from slipping far relative to the seasons. In 432 BC the Athenian astronomer Meton announced his discovery of a cycle in which there were 19x12 + 7 = 235 lunar months in 19 solar years, with the 7 intercalations arranged in such a manner that each year began with the first new moon after the summer solstice. This cycle was certainly employed widely by ancient Greek astronomers, but to what extent it was used to regulate the civil calendars of Athens and other Greek city-states has long been controversial. I shall present an overview of the epigraphic evidence that at least from the middle of the 4th century BC until the 3rd century AD, the Athenians indeed used this Metonic cycle to regulate their civil calendar (albeit with a few exceptions in times of political turmoil), and that this same cycle was used by the Delphians to regulate their own calendar in the 2nd century BC. Moreover, the Aetolians and Phocians subordinated their own calendars to that of Delphi. The widespread use of the Metonic cycle in the late Hellenistic period helps us understand the historical context in which the Antikythera mechanism was constructed.

Observation in the Social Field in Mid 20th Century America

Mary S. Morgan

Abstract: Mid-twentieth century America witnessed a flowering of studies of local American communities by anthropologists and sociologists using an open-ended field-work approach. The object of interest was the social science equivalent of 'complex naturalism': observation of the social world in its 'natural' i.e. uncontrolled state, and thus in its full complexity. Modes of observing, interrogating and recording such a social world might include surveys, interviews and ethnographies, while the material collected was held in check by limiting the geographical space or time period involved. Though such open-ended case studies were not easy to summarise into reports, particular examples - such as the Lynds' *Middletown*, or Whyte's *Street Corner Society* - proved enormously persuasive, and were widely regarded by their peers and communities as the outcomes of valid scientific research in the field. This paper analyses both the ways in which such social scientists approached their objects of study in order to observe and record those societies, and the ways that their social scientific communities received and used these case-study observations.

The Crucial Experiment - Decision-Making Catalyst in the Scientific Community

Erel Morris

Abstract: This paper explores the conditions under which the Earth Expansion hypothesis in geology was marginalized while its rival, Plate tectonics, came to be accepted by the majority of geologists. I will first examine the empirical findings that were mustered in support of each of the hypothesis and will argue that none of these when viewed independently, could really serve as a crucial experiment. I argue that a crucial experiment in the geological sciences is an observation to which a certain interpretation becomes generally accepted by the public, an acceptance after which other interpretations are neglected along with their guiding assumption. Duhem stated convincingly that there are no crucial experiments. He claimed that since the verdict of an experiment always apply to large bodies of assumptions rather than to one individual hypotheses, scientists have a great deal of discretion in adjusting their theories to the empirical findings. Nonetheless, it is often the case that certain empirical findings are perceived as if they constitute crucial evidence refuting one hypothesis and supporting another. To understand how this happens one must examine various factors such as timing, the social status of the competing scientists and the socio-institutional environment. I will show in this paper, that the general acceptance of the subduction hypothesis as described in papers by Isacks, Oliver and Sykes, demonstrated all these features, and constituted a crucial experiment marginalizing the Fast Earth expansion hypothesis.

A Scientific Intermediary between the Ottoman Empire and Renaissance Europe

Robert G. Morris

Abstract: Nicholas Copernicus (d. 1543) was the first person to propose a sun-centered cosmos for mathematical astronomy. But Copernicus did not cite earlier astronomers, whether from Europe or Islamic civilization, who worked within two hundred years of his own career. Leading experts on Copernicus have concluded that key aspects of Copernicus' astronomy must have

come from astronomers working in Islamic lands in the thirteenth and fourteenth centuries. This paper investigates one conduit of scientific information between the Islamic world and Renaissance Italy, a Jewish scholar named Mūsā Jālīnūs. Mūsū Jālīnūs, known in Hebrew as Moshe Galeano, was born in Crete and spent time in the Ottoman Sultan Bayezit's court. By the first decade of the fifteenth century, Mūsā Jālīnūs had learned of important advances in astronomy, including some that later appeared in Copernicus' work. And in the first decade of the fifteenth century, while Copernicus was at the University of Padua, Mūsā Jālīnūs traveled to nearby Venice and met prominent figures there. Not only did some of the scientific theories that Mūsā Jālīnūs described in his writings appear in Copernicus' work but other theories that he described arose in the treatises of lesser-known Renaissance astronomers. The case of Mūsā Jālīnūs is an argument for not restricting oneself to the question of the transmission of Copernicus' sources, but for thinking more broadly about connections between the Islamic world and Renaissance Europe.

Past Portents Predict: Comets, Astronomy, and Historical Astrology

Adam Mosley

Abstract: Catalogues of comets, which track their past appearances through the historical record of ancient literary texts, medieval chronicles, and more modern forms of report, are now a familiar astronomical genre. In the sixteenth century, however, such catalogues began to be produced to supply empirical evidence for the well-established view that comets were either causes or signs of terrible events: the death of kings and princes, wars, plagues and famines. Historians of astronomy, primed to think primarily of comets as playing a role in the 'dissolution of the celestial spheres', have tended to consider their supposed portentous significance as of little relevance to their treatment as physical bodies whose study helped to reshape understandings of the cosmos. But the view that comets were portents was grounded in Aristotelian natural philosophy and justified by causal explanations as well as by appeal to historical evidence. This paper will revisit some of the cometary literature of the early modern period, and show how attention to some of the less well-studied material can refine our understanding of the transformation of astronomy and cosmology during the sixteenth and seventeenth centuries. It suggests why astronomers were interested in comets before they were known to be celestial. It also helps us to comprehend some of the resistance to the new view of comets as supralunary events, as debates about comets as portents interacted with debates about their place in the universe. And it indicates one motivation for what Kepler referred to as 'the historical part of astronomy'.

Food on Fire: Quantification, Calorimetry and the Epistemology of Food

Jessica Mudry

Abstract: Over the past hundred years scientists' understanding of the relationship between the human body, energy and metabolism has translated into social and political discourses of food that are grounded in certain physical "realities," written almost entirely in the language of science. The calorie, for example, has become a pervasive unit of measure of food, and an idée fixe for policymakers, dieters and the food industry. This paper examines how science generally, and human calorimetry specifically, laid the groundwork for a new epistemology of food. By

making food, metabolism and eating measurable in calories, science makes knowledge about food. Underpinning this knowledge are numbers, statistics, probabilities, and a conception of the eater as a rational agent who sees eating as the efficient exchange of matter into energy, not as a pleasurable, social activity. Here, I tell the history of how chemists interested in theories of heat, metabolism and human energetics helped refigure food through calorimetry. I argue that the epistemological assumptions of science abetted the creation a new way of understanding food. In this new epistemology, the methods of measurement overlay food and eating, and provide a metric for making normative claims about what constitutes a proper diet. Eating has thus become the scene of a conflict of values, as rational and empirical discourses about calories usurp experiential, cultural, and qualitative discourses of food.

Early Modern Social Analysis: Nicolas de Nicolay on the Ottoman Empire

Chandra Mukerji

Abstract: Why would a Renaissance geographer develop a systematic form of social analysis? One could argue that humanist geography encouraged thought about the relationship between geography and social types, but what would encourage a geographer to question geographical determinism and look for other explanations of social differences? To address these questions, I am studying the writing of Nicolas de Nicolay describing his trip into the Ottoman Empire. What starts out as a typical piece of travel writing turns into an analysis of social types. I focus in this paper on how he thinks environment shapes character as he entertains the idea that the social environment as well as the natural environment can be a source of human differences. Looking at his descriptions of people on Constantinople, I argue that some of his may have come from Ibn Khaldun, whose critical view of urbanism seems to mirror that of Nicolay. Although it is not clear that Nicolay read Ibn Khaldun, this evidence suggests that on his trip, he started to learn not only about cultural differences, but also another tradition for thinking about social differences.

Under Glass: Physics, Biology, and the Plants in the Phytotron.

David P.D. Munns

Abstract: A phytotron should have been the most important scientific instrument of the last century, and still yet may be. As the fourth largest project funded by the American NSF in 1957 (behind radio telescopes, computing centers and nuclear reactors), phytotrons, from the Greek word for plant and "big complicated machine" its originator delighted in retelling, were computer controlled environmental laboratories. Likened to the great controlled scientific spaces of the physical sciences of the nineteenth century, the first phytotron at Caltech designed by plant physiologist Frits Went used new air conditioning systems to construct a 'scientific' space for the biological sciences. With every environmental variable exactingly and reproducibly controlled the biological sciences could finally fulfill the promise of all science – reproducible and transportable knowledge. Envisioned as the biological counterpoint to the physical sciences that had just released the power of the nucleus to power human civilization, Went's idea fired as many Cold War scientists to embrace phytotrons as the magnitude of his vision repulsed others. Yet, for about thirty years, one after another, in one country after another, phytotrons took shape and an international community of phytotronists emerged. This talk provides an introduction to the phytotron itself and to the community of phytotronists that created and sustained these large

facilities around the world. In part I will advance an argument that the rise of molecular biology has obscured its greatest rival, physiology, and hence the grand instrumental dream of physiology under the phytotron has been largely erased from historical memory.

All Movements on Film! Konrad Lorenz and the Film Encyclopedia

Tania Munz

Abstract: In the 1950s and '60s Konrad Lorenz produced a series of six films for the *Encyclopedia Cinematographica* (EC), a German-led international collaboration that aimed to capture "all movements on film." As German scientists (especially biologists) came under intense scrutiny for their wartime roles, they aimed to portray their work in a new, explicitly apolitical light. Producers of educational film, too, sought to rehabilitate their work. In the spirit of this new value-neutral science, the EC provided an ideal means of presenting nature in its truest, that is, apolitical state, as the short clips were to present movements in their simplest essence. The project lasted from 1952 to 1992, when it was abandoned for lack of further support. But in its first phases, Lorenz's work was especially well suited to the project – his science of ethology, too, aimed to establish complete surveys of behavior (or ethograms). Lorenz was an early and enduring film enthusiast and wrote to colleague and friends to rally them to the EC. His own films for the project were short segments that focused on what Lorenz considered a single behavior in male fish, and they departed dramatically from his prior film projects. I argue that the lack of narrative structure of these short films allowed Lorenz to engage in a kind of slippage between movement and behavior and to present controversial behaviors – such as homosexual mating and aggression – as discrete filmic facts.

'The Book and The Balance': Scientific Expertise, Religious Scholars, and Questions of Governance in al-Jabarti's Eighteenth-Century Egypt

Jane H. Murphy

Abstract: Abd al-Rahman al-Jabarti (1753-1825), religious scholar, teacher, astronomer, and student of medicinal herbs, is best-known for his detailed and lengthy chronicle of early modern Egypt, his multiple accounts of the French invasion and occupation (1798-1801), and depicting the rise to power in Egypt of the Albanian military leader, Mehmet (or Muhammad) Ali (r. 1805-1848). Although some scattered notice has been made of Jabarti's repeated references to scientific texts, students, teachers, instrument makers and patrons in his work, little has been made to interpret these references as part of a coherent whole. In this paper I argue that rather than curiosities these studies were quite central to Jabarti's primary concern: exploring the ways in which 'The Book' (the Qur'an and also knowledge more broadly, embodied in knowledgeable individuals like Jabarti himself) could fruitfully influence 'The Balance' (social order and justice, as meted out by members of the military and political elite). Jabarti clearly documents that shared interest in and patronage of the sciences connected members of the religious scholarly classes and military and political figures. Ultimately, I argue that we should consider the sciences in eighteenth-century Ottoman Egypt as al-Jabarti himself did, namely, one of the most important venues for bringing the scholarly and ruling classes together and therefore an ideal site to explore the possibilities of knowledge, embodied in just scholars, leading to a more just society, through the actions of knowledgeable rulers.

Egerton Smith and the Dissemination of Useful Knowledge in Early Victorian Liverpool

Cameron Murray

Abstract: Despite his significant contributions to the political, social, philanthropic and publishing histories of Liverpool, Egerton Smith is almost unknown to contemporary historians of Victorian England. This paper focuses on Smith's role as the editor of a little known miscellany called the Kaleidoscope; or, literary and scientific mirror. My treatment of the Kaleidoscope will unfold in two parts. Firstly, I want to emphasize the importance of the Kaleidoscope to the history of publishing and the popularization of science in Victorian England. Though published between 1818 and 1831, and not widely circulated, the Kaleidoscope deserves scholarly attention in this field because it was a forerunner of the general periodicals that would emerge alongside a mass, national reading audience in the middle and later decades of the Victorian period. Secondly, I will describe how Smith's liberal utilitarianism and his belief in the upward mobility of Liverpool's labouring class manifested themselves in the pages of the Kaleidoscope. Growing up during a tumultuous time in the history of Liverpool, Smith used the Kaleidoscope to disseminate scientific and technical knowledge that spoke directly to the social, political, medical and technological concerns and preoccupations of lower and middle class residents of the early nineteenth-century port town. By focusing on the life and work of Egerton Smith, I want to highlight but one historically contingent set of possibilities for configuring the role of the editor in diffusing useful knowledge to a local - as opposed to a national or international - nineteenth-century audience.

Art and Science in Botanical Publications of the East India Company

Khyati Nagar

Abstract: In the late eighteenth century, the East India Company funded the publication of *Plants of the Coast of Coromandel*, an illustrated description of plants growing in the south-eastern coast of India. The publication was authored by surgeon turned botanist, William Roxburgh and illustrated by Indian artists, under the supervision of Sir Joseph Banks. These volumes were published with the hope that they would prove useful to the Company's establishments abroad and also to the general lover of botany. *Plants* was envisioned as one of the first progressive works toward advancing knowledge of natural history in India and chiefly included plants that could be used for trade, medicine, arts and manufacturing. This publication was part of the larger vision of the East India Company to establish a formal network of botanical gardens in its colonies with an agenda of cultivating economically useful plants and for conquering nature. The theme of cultivating and taming nature in the colonies is well-explored but through the example of *Plants of the Coast of Coromandel*. I want to show that printed and illustrated scientific texts provided proof that concealed and alien nature was demystified and bound in the pages of a book. Botanical publications acted as culturally mediated contact zones and presented unknown plant species from India as familiar, to Europeans, through the homogenizing visual and textual language of scientific descriptions and illustrations. This publication is also an example of the confluence of western and eastern traditions in the visual rendering of plant species.

Shaping a Local Style: Bunsen's Teaching in the Heidelberg Context

Christine Nawa

Abstract: In the second half of the nineteenth century, the University of Heidelberg was a stronghold for the physical sciences. The chemist Robert Wilhelm Bunsen (1811-1899), who entered the Ruperto Carola in 1852, clearly helped shaping this image: With his arrival chemistry moved from the medical to the philosophical faculty, and pharmacy was divided from chemistry. Bunsen played an important role in bringing his colleagues Kirchhoff, Helmholtz and Kopp to Heidelberg, thus forming the requirements for a successful interdisciplinary experimental culture centered on the use of physical methods. Bunsen is best known for improving gasometrical methods and for laying the scientific foundations of spectral analysis with his colleague and friend Kirchhoff. So far but little attention has been paid to the fact that Bunsen also decisively influenced the culture of teaching in Heidelberg. His lectures on experimental chemistry served as a model for many renowned scientists, among them Hermann Helmholtz. In my talk I will analyze the characteristics of Bunsen's teaching style and its effects on chemistry teaching in Heidelberg. I will argue, that the key for the understanding of Bunsen's teaching style lies in the aspects of performativity and the continuous personal contact between the professor and the students. Bunsen's teaching served as a point of reference for other chemistry Dozenten in Heidelberg. However, as Bunsen excluded them from the use of his laboratory, in Heidelberg a decentralized teaching structure emerged that was significantly different from other German universities at that time.

The Statistical Bodies of Early Nutrition Science

Elizabeth Neswald

Abstract: Late nineteenth-century nutrition science occupied an ambiguous space, connecting theory and practice, studies of individuals and studies of populations, methods from the natural science and methods from the social sciences. It aimed at the precision of physics and chemistry but was confronted with the enormous variability of its subjects, objects and circumstances and with discrepancies between the artificially controlled conditions of the laboratory and the variable conditions of human life. This paper explores how some of these tensions expressed themselves in the search for dietary standards and the establishment of nutritional norms in early nutrition science. It will show how these norms emerged from interactions between laboratory nutrition and digestion experiments, on the one hand, dietary surveys and consumption budgets on the other, that is, studies of individuals and studies of groups, specific and statistical data. While early nutrition research studied individuals and postulated nutrition norms on this basis, the dietary surveys of the late nineteenth-century collected food consumption data for diverse population groups, assuming that average consumption would reveal physiological norms and thus provide a basis for developing dietary standards. By the early twentieth century, group metabolism experiments, made possible by the shift from direct to indirect calorimetry, generated a new epistemological object – a metabolic body that existed only as an average, stripped of social roles, characteristics and individuality.

City under the Ice: The Closed World of Camp Century

Kristian H. Nielsen

Abstract: This paper uses Paul Edwards' closed world metaphor to understand US involvement in Greenland during the Cold War. Closed worlds mark military-techno-scientific geographies of conflict: They refer to sealed techno-spaces of observation, containment, and control, but also to the settings in which military conflicts are taking place. Studying the wealth of public representations of Camp Century, established 1959-60 by the US Army 128 miles east of the Thule Air Base and often referred to as the "City under the Ice", we find a sharp contrast between the domesticated interior and the superpower conflict that gave impetus to the camp's construction. Presented to the public as a scientific station and a technologically-advanced, under-ice extension of the American way of life, while situated in the titanic struggle between West and East, Camp Century took on a number of closed-world meanings: The public image of Camp Century was one of technological comfort and military-scientific control. Amidst the raging Cold War and up against the harsh environment, the construction of the camp would prove to the public that the combined forces of the US military-technology-science complex would prevail. However, the military logic of Camp Century was self-referential and closed in the sense that the very idea of constructing the city under ice emerged from Cold War strategy. The closed world of Camp Century established a temporary boundary between, on the one hand, the comfortable space controlled by US ideology and, on the other, the bleak environments defined by Arctic climate and the Cold War.

The Griffin's Dilemma: Reconstructing Archaeopteryx, 1861-c.1990

Ilja Nieuwland

Abstract: The importance of the fossil of the ancient bird *Archaeopteryx lithographica* was realised quickly after its discovery in 1861. The first specimen of this hybrid reptile-to-bird was found a only year after the publication of Darwin's *Origin of Species*, and provided his defenders with exactly the sort of evolutionary ammunition they needed. Yet this iconic role made it difficult to arrive at convincing life reconstructions. Any portrayal of Archaeopteryx needed to flaunt its intermediary characteristics whilst also remaining believable as a live animal. As ideas changed about the significance of these characteristics, and the relation of the animal to dinosaurs and birds, subtle changes occurred in the iconography of the animal. Yet Archaeopteryx's iconic status, its importance in the representation of paleontology, demanded that some recognizability be maintained. This paper will treat the way in which 'paleo-artists' attempted to incorporate the necessary anatomical, evolutionary and even social and political viewpoints in life reconstructions of the most important bird in paleontology through the past 150 years. I will attempt to shed light on the modalities, social and scientific, which dictate the representation of extinct animals.

Containing Wartime Brains: Japan's Lack of a Brain Drain during the U.S. Occupation, 1945-52

Takashi Nishiyama

Abstract: This paper examines Japan's lack of a brain drain among its engineers in broad

historical, international, and comparative frameworks. A series of comparisons with Germany reveal how and why postwar Japan was able to contain former military engineers for its postwar buildup. From 1945 to 1952, the emigration of ex-military scientists and engineers from Japan was uncommon. Both the examples and counter-examples of this migration pattern highlight the following underlying factors: (1) the importance of geography, (2) international politics in Asia (i.e., among Australia, China, the Soviet Union, and the United States), (3) legal and economic impediments, and (4) socio-cultural expectations (including gender and birth order). All of these factors hindered the exodus of military engineers during the U.S. Occupation of Japan. Lacking the means and paths to pursue an exodus, ex-military engineers were contained in the country and migrated domestically into the civilian sector. Their absence from the post-1945 emigration in any significant numbers ensured that their wartime expertise was passed on exclusively in Japan.

Hormones of Life: Endocrinology, the Pharmaceutical Industry, and the Dream of a Remedy for Sterility

Christer Nordlund

Abstract: In the summer of 1948, the Danish pharmaceutical company Leo called a press conference. The next day, news spread that in collaboration with scientists at the Royal Caroline Hospital in Stockholm, the company had discovered a cure for sterility to be called Gonadex. At the time, Gonadex appeared at the forefront of research in reproductive endocrinology. Today, however, few remember that this drug ever existed. What went into its design and development? How was it launched and received? And why did it remain on the market for decades despite never actually showing results? By answering these questions, the aim of this paper is to demonstrate some significant changes in the moral economy of pharmaceutical hormone research that took place in the first part of the 20th century. These changes gave rise to and were shaped by increasing interaction and reciprocity between pharmaceutical firms, academic life scientist and physicians, and they affected not only research and production but also public marketing of drugs such as Gonadex. The paper draws on the book *Hormones of Life: Endocrinology, the Pharmaceutical Industry, and the Dream of a Remedy for Sterility, 1930–1970*, to be published by Science History Publications/USA in the summer of 2011.

Gustav Kirchhoff in "New Soil": Heidelberg and the Evolution of 19th-Century Physics

Kalil Oldham

Abstract: Gustav Kirchhoff is best known among historians of science for his work with the chemist Robert Bunsen on the spectral analysis of chemical compounds and his law relating the emissive and absorptive power of materials. Philosophers of science know Kirchhoff for what I have called his "doctrine of description" – his provocative assertion that the purpose of the natural sciences is the description of events in the natural world and explicitly not the explanation of their causes. Kirchhoff developed both of these central ideas as part of the rich intellectual ferment of the University of Heidelberg in the mid-nineteenth century. After his move from the University of Breslau in 1854, for Kirchhoff Heidelberg offered new challenges and new opportunities. His work with Robert Bunsen brought Kirchhoff international prestige. During the late 1850s and early 1860s, in dialogue with colleagues such as Hermann von

Helmholtz and Eduard Zeller, he gradually became more interested in methodological and epistemological issues concerning theoretical physics and the natural sciences in general. He began to consider the "purpose of the natural sciences" as somewhat distinct from the aims of theoretical physics, and in so doing he fashioned a philosophically interesting perspective on his work and that of his contemporaries – the doctrine of description. Coming to Heidelberg, therefore, led Kirchhoff in two new directions: first, toward more meaningful experimental work, and second, toward a thoughtful consideration of his aims as a theoretical physicist and his purpose as a natural scientist.

Naomi Oreskes, Professor of History and Science Studies at the University of California, San Diego

Naomi Oreskes

Abstract: Naomi Oreskes is Professor of History and Science Studies at the University of California, San Diego, and an internationally renowned historian of science and author. For the past twenty years, she has studied the process of consensus and dissent in science: How do scientists decide when a fact is "established?" How do they judge how much evidence is sufficient to deem something scientifically demonstrated? And what happens when scientists can't agree? In 2004, she began to investigate the question of what scientists had to say about global warming , and quickly realized that scientific experts had a consensus on the reality of global warming and its human causes. Her essay "The Scientific Consensus on Climate Change" (Science 306: 1686), led to numerous Op-Ed pieces, including in the Washington Post, the Los Angeles Times, and the San Francisco Chronicle. This work has been widely cited in the mass media in the United States and Europe, including in the Royal Society's publication, "A guide to facts and fictions about climate change," and in the Academy-award winning film, *An Inconvenient Truth*. Her latest work is *Merchants of Doubt, How a Handful of Scientists Obscured the Truth on Issues from Tobacco to Global Warming,* published in 2010 by Bloomsbury Press, a finalist for the 2010 Los Angeles Time Book Prize.

Collaborating with the Enemy: Conflicting Agendas in the Republic of Letters

Carol Pal

Abstract: Late in 1634, as the Thirty Years' War pitted Catholic against Protestant in a devastated Europe, a Catholic philosopher met a Protestant scholar to have a tea-time conversation in The Hague. The topic under discussion was Truth, and how to find it. The Catholic philosopher was René Descartes, who advocated the use of algebra. His Protestant colleague, the ecumenicist John Dury, considered Scripture to be the infallible source. They would never agree, but they parted friends – and Dury immediately went back to his mission to unite all Protestants against Catholics like his colleague Descartes. This might at first seem a rather improbable conversation. On the one hand, this meeting typified the transnational ideal of the republic of letters, wherein scholars transcended confessional difference in order to further the advancement of learning. But on the other hand, there was no shift of confessional allegiance, and no softening of the religious agenda. Yet this was not a one-off, nor should it be seen as a temporary truce. Rather, this paper argues that throughout the seventeenth century, cross-confessional collaboration was carried on simultaneously with confessional conflict – and often

by the very same persons. Scholars in the republic of letters inhabited multiple concurrent identities, shifting from one to another as need arose. And the ideal of the republic of letters did not, in fact, transcend confessional conflicts – instead, it co-existed with these conflicts, as scholarship and religious wars were constantly interwoven to create the fabric of early modern intellectual culture.

The Politics of Experiential Reality and the Piety of the Laboratory

Katherine Pandora

Abstract: Critiques that emerged within the social sciences of objectivist definitions of right practices, legitimate knowledge, and professional authority have yet to be adequately understood as integral to 20th-century debates in the United States about the nature of science more generally. In part this is due to the tendency to view the social sciences as lagging indicators of cutting-edge scientific change forged at the core of "modern science." Rather than a defensive stance on how "the social" compromised "objectivity," however, these more assertive critiques instead focused on how problematic aspects of "objectivity" revealed within social science rendered normative depictions of "science" more generally as needing reformulation. The disruptive nature of these critiques is brought back into view by tracing variations on the discourse of "the piety of the laboratory," which emerged in the American context in the radical empiricism enunciated by William James, in which he called for an approach to the study of nature capable of "lying flat on its belly in the middle of experience, in the very thick of its sand and gravel." The intellectual, political, and cultural weaknesses of a science unable to manage this feat were themes that were developed by later cohorts of social scientists, as with the ones I examine here – anthropologist Ruth Benedict and psychologists Gordon Allport and Roger Barker – and the force of their arguments about the professional stakes that held at mid-century for whether expansive or restrictionist visions of the nature of science would take hold remain relevant today.

"Black Dandelion": Science, Court, and the First Environmental Disease in Korea

Buhm Soon Park

Abstract: In March1987, a shocking article was published in a daily newspaper of Korea that a woman living in the residential area of Seoul was diagnosed with the "coal miner's disease." It was pneumoconiosis, a disease caused by the damaging of lung tissues by minute iron and stone particles. The reported victim was Gillae Park, a middle-aged single woman who used to run a restaurant before being struck by the disease. She filed a lawsuit against the owner of a nearby factory producing coal briquettes, and it had taken about a year's intense debates and epidemiological studies before the court made a ruling in favour of the plaintiff—the first court decision in Korea acknowledging a pollution-related disease. Fondly remembered as "black dandelion," Park became an inspiration for many environmental activists for years. As typical an environmental episode as it may appear, I contend that this case cannot be fully understood without considering the socio-political context of Korea. The year 1987 was the watershed for Korea's democratization movement that led to the fall of the military regime; and it was Youngrae Cho, a prominent figure in the democratization movement, who served as a lead lawyer for Park's case. Analyzing Cho's handling of the case, I argue that his goal of

democratization—which was not just to restore the civilian government but to protect human rights through proper legal processes—had ramifications for his boundary work between science and law to keep the legal case from becoming a captive of scientific expertise.

Gaps in the Record: Henry Fairfield Osborn, George Gaylord Simpson, Ernst Mayr and the History of Evolutionary Paleontology

Miranda Paton

Abstract: The American vertebrate paleontologist, Henry Fairfield Osborn (1857-1935) and Ernst Mayr (1904-2005), the systematist who did so much to shape our understanding of the Evolutionary Synthesis of the 1930s and 1940s, had a great deal in common. Osborn and Mayr wrote critical revisionist histories in order to argue against the wisdom of organizing all of evolutionary research around genetics. Between them, George Gaylord Simpson (1902-1984) reconciled micro- and macroevolution during the mid-century unification. He later refused to write that history. When Mayr reconstructed an authoritative history and definition of the Evolutionary Synthesis in the 1970s, he had several motivations. He wished to correct scientists and historians who focused on genetic research and theoretical population geneticists' views of evolution. Though Mayr appears neutral with respect to paleontology in his published work, his correspondence reveals something more. Mayr objected vigorously to Osborn's views of evolution but also to post-Synthesis products of paleontology-- notably Punctuated Equilibria and cladistic classification. Osborn, whom Mayr and Simpson had both known personally, fared unevenly in their hands. Osborn wrote about the history of evolutionary theory and that work informed his objections to Mendelian geneticists' research. Osborn's anti-Darwinian views of evolution were remembered and his informed objections, some of which Simpson understood quite well, were forgotten. This case suggests that history-writing projects are not epiphemenomal to the science surrounding them. I argue instead that historical accounts of evolutionary biology's moments of unification reflect central components of debate at the time they were produced. Those histories—the ones written and the ones unwritten—exert real effect on subsequent discussions of evolutionary research.

How PKU Became a Genetic Disease

Diane Paul

Abstract: Although it had been recognized since the 1930s that phenylketonuria (PKU) was an inherited disorder, that fact received little attention in the 1960s when population-wide screening began. At the time, PKU was framed as a treatable form of mental retardation, and its genetic etiology seemed unimportant. That situation would change with the explosive growth in the field of medical genetics that culminated in the international effort to sequence of the complete human genome. By the 1980s, the PKU "success story" had come to play a central legitimating role for genetic medicine generally and genetic testing in particular -- despite the fact that screening had been routinized in North America and much of Europe two decades before the phenylalanine hydroxylase gene had been cloned, and genetics has since contributed little either to diagnosis or therapy. This paper traces the "geneticization" of PKU, its transformation into a paradigm for genetic medicine, and the use of that paradigm to legitimate both genetic research and testing.

Dewey before James: Evolution and the Organic, 1875-1889

Trevor Pearce

Abstract: The American philosopher John Dewey was no romantic: "Romanticism is an evangel in the garb of metaphysics. It sidesteps the painful, toilsome labor of understanding and of control which change sets us, by glorifying it for its own sake." Nevertheless, his philosophy – like that of the German romantics – consistently opposes the organic to the mechanical and emphasizes notions of development and evolution. These tendencies in Dewey's thought – i.e., this apparently strictly biological vocabulary – are often attributed to his early-1890s conversion to the "biological conception" of the mind. In this talk, I will show that Dewey encountered a variety of discussions of evolution and the organic at the University of Vermont (1875-1879), Johns Hopkins University (1882-1884), and the University of Michigan (1884-1889) prior to his embrace of the "biological conception" upon reading William James's Principles of Psychology (1890). What appears in Dewey's work to be straightforwardly biological vocabulary is instead (or also) the vocabulary of German idealism, itself influenced in decisive ways by biology.

Towards a Definition of Pleasure in Practices of Looking

Sharrona Pearl

Abstract: How do we think about the experience of looking? This paper will explore the ways in which looking has been organized and analyzed historically, focusing in particular on controversial or forbidden sites and images. I argue that looking – and its associated thrills and pleasures – has often being disciplined through medical and educational rhetoric, giving viewers permission to see and stare with the knowledge this it is good for them and therefore, in some larger sense, both good and okay. While this paper will deal with broad themes in the history of looking scholarship, I will use Victorian freak shows and freak show images as a case study to illuminate the various approaches to looking and its justification. To do so, I will offer a series of examples of looking practices that have been determined problematic, pornographic, and voyeuristic, arguing that the historical industry has played an important role in the organization of these categories and their underlying politics. I will think through the ways in which looking has been organized and studied biologically, sociologically, historically, psychologically, and theoretically, arguing for a new approach to looking that takes seriously the role (and importance) of pleasure not just in our practices of looking but in the ways that we actually see.

Myth, Magic, and Minerals: John Dee and the New World

Tricia R. Peone

Abstract: John Dee (1527-1608) formulated ideas that helped to shape English involvement in the New World from the first Elizabethan voyages well into the seventeenth century. While much has been written about Dee, this paper seeks to demonstrate the important contribution of his scientific and magical thinking to early American exploration and colonization enterprises. More specifically, Dee's interest in these enterprises derived from his belief that the New World would be crucial to establishing a spiritual "Brytish Impire" – that England would be at the center of the world as a new age dawned. Dee used Arthurian legend to promote the idea that

Queen Elizabeth held an ancient claim to the New World which trumped the claims of competitors for North American lands. Although he did not ever visit the New World, Dee directly participated in several of the early voyages by advising explorers such as Martin Frobisher and Humphrey Gilbert and evaluating their discoveries. Dee also played a key role in the earliest debates over exploiting American mineral resources, encouraging others to scour the landscape for substances that could yield alchemical and financial rewards. Dee's practical application of magical ideas to English colonization efforts had a lasting influence on early America; his legacy is especially evident in the enduring expectation that the English could make the New World divulge nature's secrets for their exclusive profit.

Popularizing Evolution: Steven Jay Gould, Professional Values and Neo-Darwinism, 1980-2002

Myrna Perez

Abstract: Throughout his career, Stephen Jay Gould was a vocal critic of what he called the 'fundamentalism' of neo-darwinism, and the 'hardening' of the premises of the modern synthesis. This paper explores the relationship between Gould's disagreements with various aspects of the neo-darwinian synthesis and a larger discourse on the public understanding of evolutionary in the US from 1980 to 2002. I aim to explore the impact of the activity of popularizing evolution on professional scientific identity. Gould's criticisms of neo-darwinism were challenged by figures such as Richard Dawkins, Daniel Dennet and John Maynard Smith. Many of his critics were concerned that Gould was misrepresenting Darwinian evolution to the general public, and laying the validity of evolutionary theory open to general attack. In 1995, John Maynard Smith claimed Gould gave "non-biologists a largely false picture of the state of evolutionary theory." This point was given additional sociopolitical burden by the Creationist movement's challenge to the teaching of evolution in American high schools. Gould was even accused of being an 'accidental creationist'. Current scholarship on Gould has often focused on the "Darwin Wars" as an ideological conflict. I argue that these genuine intellectual disagreements were given added force because of the concern that Gould was projecting to the public an incorrect view of evolution, and that the scientific consensus on the fact of evolution was not absolute. Utilizing archival resources, this paper emphasizes that Gould's identity as an evolutionary biologist was alternatively questioned and solidified by his activities as a public intellectual.

Helmholtz and the Sirens: Sound, Color, and the Problem of Space

Peter Pesic

Abstract: Hermann von Helmholtz's *On the Sensations of Tone as a Physiological Basis for the Theory of Music* (1863) illuminated musical evidence through experiments with mechanical sirens that connected audible with visible phenomena, showing how the concept of frequency unifies motion, velocity, and pitch. From these observations, he then drew a "close analogy ... in all essential relations between the musical scale and space" in its geometrical sense. To these arguments based on hearing, Helmholtz added his observations on the non-Euclidean character of the three-dimensional "manifold" of color sensation. During 1866-1870, he then applied these facts about the "spaces" of hearing and seeing to the question of determining the most general form of distance-relations in geometrical space. Helmholtz used his investigations in sound and

light to provide physical rationales supporting the quadratic distance-relation (generalizing the Pythagorean theorem) that Bernhard Riemann had assumed as the point of departure for his famous lecture "On the Hypotheses that Lie at the Foundation of Geometry" (1854). Einstein later acknowledged the paramount significance of the work of Riemann and Helmholtz in laying the groundwork for general relativity. In this, Helmholtz's use of audible and visible evidence helped him make essential contributions to the "problem of space."

GIS in Pursuit of Food History

Gabriella M. Petrick

Abstract: Geographic Information Systems (GIS) are a new way to interpret the world. Although typically used to provide directions or visualize census data, GIS can be a useful tool for historians. My current project maps bakeries in New York City from 1900-1955 to illustrate how large-scale food production changed the cityscape, and therefore the lives of New Yorkers. Not only did the sensory aspects of the city change, but the ways in which New Yorkers acquired their foods also changed dramatically. By creating a database from directories and telephone books and mapping the bakeries, we can literally see how the city changed by utilizing digitized historical maps. We can trace how particular districts became more or less industrial over the course of the century and the flow of food throughout the city. We also can analyze how various ethnic groups shaped the foodscapes of their neighborhoods and shifted their eating patterns by looking at bakeries relative to other types of food spaces. The true power of this type of research only becomes apparent when it is online and dynamic, presenting a unique set of problems for researchers publishing in traditional journals. The costs of creating historical databases also constrain widespread use of this type of data. However, robust databases can be "recycled" into new projects and allow for collaboration across fields. Although generally a longue durée project, this new type of research can bear fruit and link current science with historical questions.

The Scientist as Clinical Subject: Historicizing Anne Roe's Studies of Creativity

Michael Pettit

Abstract: During the early 1950s, Anne Roe undertook the project of having leading scientists serve as subjects of psychological assessment to ascertain the nature of their creativity. Alongside oral history interviews, she used then leading diagnostic tools, the Rorscach and Thematic Apperception Test. How can historians use this rich archive of self-talk in an era when these instruments are widely seen as invalid? Moreover, the psychologists she interviewed made clear that they were uniquely problematic subjects since (unlike other scientists) they were knowledgeable about the test Roe administered. This paper focuses on the encounter between Roe and the comparative psychologist Frank Beach. I offer a historical frame analysis of the resulting clinical records. Roe's interview with Beach represents a rather unique a mid-century encounter between two strands of twentieth-century sexology: psychoanalysis and neuroendocrinology. I will explain the cultural status of these tests at the time of Roe-Beach encounter while also elucidating the attitudes towards psychoanalysis that Beach brought to the interview. Rather than viewing his responses as either unintentional revelations of his submerged inner psychic or his cynical manipulations of a credulous clinician, I want to examine them as a genre of performance through which he enacted his sexuality. The overall aim of this paper is to

develop some interpretative strategies for historians grappling with the clinical data collected from another era.

Mirror of the Mind: Chalkboards and the Practice of Mathematics

Christopher Phillips

Abstract: While paper and pen have long been central instruments of mathematicians, the chalkboard has come to hold a ubiquitous place in mathematics pedagogy and practice. Moreover, the chalkboard foregrounds important questions about the role of instruments and materiality in mathematics: Where does mathematical cognition actually take place? How does consideration of the material culture of mathematics change historical narratives of the field's development? Scholars have begun to investigate the role paper exams, seminar room tables, and electronic computers play in the production, validation, and communication of mathematical knowledge. This paper uses the mid-nineteenth century dissemination and eventual mass production of the chalkboard to examine the way in which certain surfaces were said to be especially good for doing and learning mathematics. In particular, the paper traces how advocates' claims about the benefits of chalkboards often involved explicit acknowledgment of their role in cognitive processes--as one promoter explained, chalkboards were literally the "mirror of the mind," revealing otherwise invisible processes, and thereby aiding both students and practitioners. Taking such statements as a starting point, this paper argues for the importance of devices like the chalkboard for the development of practices often considered purely "cognitive," and for the centrality of material culture within the history of mathematics.

In the Clover: Agricultural Productivity, Profit, and the Science of Running Farms in German-Speaking Europe

Denise Phillips

Abstract: The eighteenth century has been called the golden age of food riots; in the nineteenth century, political uprisings often followed on the heels of bad harvests. For German elites in these centuries, few issues loomed larger than the problem of an adequate food supply. Agricultural improvement was often framed as a patriotic cause, something that served the general good and preserved public order. At the same time, many German noble landowners were aggressively entering the pan-European market, while others teetered on the brink of bankruptcy. For all these reasons, agricultural expertise was a valued public good, but deciding what kind of expert to trust was no easy matter. Early champions of academic agricultural science claimed they knew how to make farms more prosperous, but so did a growing number of more practical agricultural authors, men who often scoffed at the learned pretentions of professors. My paper explores how Germans' evolving ideas about profit and self-interest affected their evaluation of agricultural expertise. According to dominant images of both the learned and the noble, seeking profit was beneath the dignity of people in these estates. Yet few things could make a man's name in agricultural circles more quickly than the news that he ran an estate with high yields and large profits. In contrast, the "model farms" of important academic figures like Thaer often survived only through external subsidies. A major aim of the paper is to explore how the champions of Wissenschaft dealt with the problem of their indifferent financial successes.

God and Rainfall in Prices: Theories of Periodicity in Weather and Market Forecasting in the Late-Nineteenth and Early-Twentieth-Century United States

Jamie Pietruska

Abstract: This paper examines the migration of theories of periodicity from weather to market through the work of long-range forecasters Samuel Benner and Henry Helm Clayton. Benner, an Ohio farmer and "self-styled prophet" of commodity prices, published the popular series of *Benner's Prophecies of Future Ups and Downs in Prices* in the late nineteenth century that applied theories of meteorological periodicity to commodity price cycles. Clayton, a weather forecaster for a private Massachusetts observatory and subsequently the U.S. Weather Bureau, earned recognition for his five-day forecasts and subsequently explored potential correlations between meteorological cycles—in precipitation and solar radiation—and an array of ecological and economic trends, from animal populations to tree ring cycles to stock prices. Although theories of meteorological periodicity and correlation would fall out of favor beginning in the early twentieth century, both Benner and Clayton grappled with the epistemological implications of their forecasting practices and sought to construct conceptual frameworks for predictability during the probabilistic revolution. This paper considers Benner and Clayton as theorists of forecasting and reveals that their efforts to popularize theories of long-range predictability won them both public acclaim and criticism as they entered into broader late-century debates over who had the authority and expertise to predict the future.

Sciences of Simulation and Detection: The Butterine Controversy and Federal Regulation in America, 1870-1910

Rachel Ponce

Abstract: In the late nineteenth century, artificial butters were the products of successful scientific efforts to simulate natural butter. First discovered and produced in France, they were hastily adopted by manufacturers in the United States as cheaper and safer alternatives to natural butter, but the widespread production and sale of these products became almost instantly a contentious issue in the United States. Unlike our contemporary debates weighing comparative nutritional values of margarine versus butter, the debates that raged over the debut of oleomargarine and butterine were almost exclusively about fraud. Made from rendered animal fats and vegetable oils, these products were virtually indistinguishable from natural butter that was made from milk fat. I argue that it was because these artificial butters too closely approximated nature that they became the center of heated public debates about deception in the marketplace and adulterated foods. Attempts to detect differences between margarine and butter through chemical analysis proved largely inconclusive. This inability to discriminate between the two had important consequences both for the public perception of science and in increasing the police power of the federal government. The impotence of science in rooting out the suspect butterine led many to believe that scientists willingly colluded with industry to profit off of an easily duped citizenry. And when science could not tame the controversies it had created, it was the federal government who ultimately intervened, making unprecedented use of the power of taxation, not to raise revenue, but to restrict and curtail the sale of oleomargarine.

Cases and Statistics in the Nineteenth-Century Asylum

Theodore Porter

Abstract: Nineteenth-century asylum patients had all the characteristics of a population yearning to be quantified, and the alienists were happy to oblige. Yet they also complained often that the numbers didn't seem to prove anything. The prevailing response, internationally approved, was to pursue standards. This meant uniform categories, so that numbers from Illenau, Charenton, and Worcester would be compatible with Bedlam, and could be combined into much bigger numbers that would reveal answers to pressing questions. It also meant standardizing the collection of patient data to make the numbers reliable. But this would presume that hospitals were or could be made almost identical, and there were abundant reasons that the asylum could not be standardized. At least this was the argument of F. W. Hagen, who offered his asylum in Erlangen as the model of different kind of statistics that would amass numbers over time as well as space and would incorporate local knowledge of the patients in a particular place. In practice, the standardization project was only marginally successful, and asylum statistics took shape in relation to disparate institutional cultures and to the typical medical genre of (somewhat) individualized case histories.

Putting Emblems into Practice: Tycho Brahe's *Astronomiae Instauratae Mechanica*

Jasper van Putten

Abstract: This paper argues that Tycho Brahe, in his instrument book *Astronomiae Instauratae Mechanica* (Wandsbeck: 1598), made strategic use of emblems to present his work as an inherently moral and Christian endeavor to potential patrons. Tycho printed the *Astronomiae Instauratae Mechanica* on his private press in order to showcase his astronomical instruments to European rulers in a bid to acquire patronage after the loss of the observatory Uraniborg. Still, due to shortage of time and resources Tycho had to reuse twenty-six old and worn woodblocks from earlier publications. The strategic inclusion of five newly cut engravings, especially the two emblems, serves to target a high-class audience and to impress the moral basis of his work on them. The book opens with a small and unassuming brass quadrant that boosts an emblem with the inscriptions *Vivimus ingenio coetera mortis erunt* and *Vivimus in Christo, coetera mortis erunt*. Since Tycho also signed *alba amicora* with this motto, the first engraving functions as a personal emblem of scientific theory. Religious considerations indeed permeated his life's work: the Tychonic system of the cosmos, a systematic attempt at the reconciliation of post-Copernican astronomy with religious beliefs. I suggest that the second engraving of the famous wall quadrant showing Tycho at work is an emblem of practice. The two engravings functioned as pendants denoting the moral ideals behind the astronomer's work, in theory and in practice. These were valuable messages to lure Christian patrons in the precarious times after Copernicus.

Ship as Instrument: The R/V Alpha Helix and Human Biological Research, 1966-1977

Joanna Radin

Abstract: In his account of 18th century geography, Richard Sorrenson considered the ocean-going ship as an instrument in the mapping activities performed by Captain James Cook. He

identified three key dimensions of this ship's instrumentality: it expressed authority; left traces in the medium through which it passed; and provided a superior, self-contained, and protected view of landscapes and civilizations encountered. It is possible to discern all of these features, as well as to describe others, in the Alpha Helix – a Cold War era, National Science Foundation-supported research vessel. In this paper I examine the practices and politics that enabled this floating lab to be adapted to support blood serum surveys among geographically isolated human populations. As an instrument, the Alpha Helix supported a syncretic mode of knowledge-making that blended older natural historical approaches and newer experimental and molecular ones. Similarly, the ship expressed globalizing desires that reflected both older imperial aims and emerging postcolonial realities: to bring centers of calculation to the periphery and to locate the center at the margins, to shrink the globe while revealing new frontiers, to highlight difference while refining novel techniques of standardization, to salvage 'old' fragments and subject them to totalizing cutting-edge analyses. In the case of those human biologists who used the Alpha Helix, it became a floating freezer, capable of simplifying the cold chain seen as necessary for successfully transforming pieces of native bodies into standardized resources for the study of biological variation.

In Pursuit of Irregularity: Sparks and Standards in Victorian Physics

Chitra Ramalingam

Abstract: Many of our most insightful histories of nineteenth-century physics are stories about standardization. The establishment, dissemination, and control of standards for electrical measurement, for example, was one of the great projects of late Victorian physics, one which presented great technical and political challenges, and which drove the institutionalization of many important experimental techniques and sites. As a scientific object the electric spark had an ambiguous place with respect to these developments. Its complexities eluded the disciplined routines of precision measurement that underlay the electrical standards program. The physicist James Clerk Maxwell was forced to exclude discharge phenomena from the reach of his influential theory of electromagnetism in 1873, as well as from the experimental program of his new Cavendish Laboratory at Cambridge, which became a center for laboratory trials of electric resistance standards. Yet despite its displacement from the new institutional physics labs, discharge research continued to flourish in the last few decades of the century, in the work of independent, idiosyncratic researchers like William Crookes, Warren de la Rue, and William Armstrong, among others, before finally finding its way into the experimental agenda at Cambridge under J.J. Thomson. This paper resurrects the trajectory of this alternative experimental program in Victorian physics--in particular, its focus on capturing and representing the beauty and irreducible complexity of discharge phenomena--and examines its relations to the discipline's standardizing framework in this period.

The Transmutation of Alchemical Medicine in Early Modern England

Jennifer Rampling

Abstract: Throughout the sixteenth and seventeenth centuries, English medical discourse was shaped by the theories and practices of chemistry, as advocates of alchemical, Galenic, Paracelsian and Helmontian medicine shared knowledge and engaged in fierce polemics. The

effects of these encounters were experienced on both sides of the Atlantic. Yet how much common ground did these approaches have, and where did they diverge? This paper explores the late medieval antecedents of these disputes, focusing on a palette of alchemico-medical practices originally (but spuriously) attributed to the Majorcan philosopher Ramon Llull. From the fourteenth century to the seventeenth, pseudo-Lullian alchemy was reinterpreted by successive generations of practitioners. In print and manuscript, traditional readings jostled alongside radical new interpretations, as the same recipes were re-read in light of new alchemico-medical philosophies (notably those of Paracelsus and Van Helmont), adapted to new methods and materials, and accommodated to new geographies. On the one hand, long-established practices (such as those employing lead compounds) were challenged by new approaches, notably the 'antimonial' alchemy popularised by the Bermuda-born alchemist George Starkey (1628–1665). On the other, a more traditional reading presented alchemical elixirs as a gentler via media between the extremes of Galenic and Paracelsian practice.

On the Limits of Limit Values

Carsten Reinhardt

Abstract: Limit values (also known as threshold or boundary values) are an important instrument, or concept, of regulatory policy, especially in dealing with chemicals at the workplace and environmental pollutants. The main functional asset of limit values as a regulatory concept is, arguably, their capacity to carry the necessary ambiguity for connecting different spheres while fulfilling specific functions in each system. Though the meanings of limit values are different in labor law, analytical chemistry, toxicology, cancer research and occupational health, respectively, they have to refer to each other in order to function properly. In this sense, I borrow the notion of regulatory concept from work on boundary concepts and boundary objects in science studies. The talk will address the limitations of limit values as a regulatory concept in a threefold way: First, some inherent conceptual limitations will be clarified; second, a comparative study on the uses of limit values in occupational health by the regulatory cultures of France and the Federal Republic of Germany from the 1950s to the 1980s will be presented; and, third, it will be argued that the limitations of the concept were a crucial precondition for its success, and did not lead to its failure.

Of Axolotls and Men, Or, How the Aquarium Brought Life to the Life Sciences, 1864-1900

Christian Reiss

Abstract: This paper explores the history of an integral, but mostly neglected technology in the life sciences – the aquarium. Denounced as a hobby and spectacle, the aquarium seems to have appeared almost miraculously as a functioning part of many laboratories. But, as I will show in my presentation, the science part is unthinkable without the hobby and spectacle part and shows how laboratories were constructed for the different needs of both researchers and research organisms. Drawing on my research on the history of European aquarium culture, I will show how its pervasiveness and popularity were both products of and reactions to processes of industrialization and urbanization. Being partly rooted in the context of the acclimatization and zoo movement, the aquarium was one way of keeping exotic animals and played a major role in

the practical shift from dead specimens to living animals, turning natural history into an experimental science. This new practice depended on the establishment of places and technologies to create research habitats in which both animals and scientists could come together. Focusing on the history of the Mexican axolotl, I will show this transition from a colonial curiosity, via aquarium fanciers, to a laboratory animal. In parallel, the pragmatic challenge of keeping research organisms alive and the resulting habitat knowledge fostered the emergence of a specific kind of ecological knowledge. As I will show, aquarium fanciers turned out to be crucial in this process of habitat construction, turning a fragile assemblage into a ready-made technology.

The Astronomical Club

Joan Richards

Abstract: The first meeting of the Astronomical Society of London took place at the Freemason's Tavern in London on January 12, 1820. The formation of the Royal Astronomical Society has long been recognized as a key component in the formation of a new form of scientific practice in the early British nineteenth century. Less well known is the story of the Club, a more informal group that from the very earliest years of the society, stayed on long after the formal meetings were over in order to continue their conversations over dinner and drinks. In its early nineteenth-century manifestation, the Club was a hold-over from an eighteenth-century world in which all of Astronomy was amateur Astronomy. Key members in the 1830s and 40s included John Herschel, Francis Baily, Richard Sheepshanks, George Biddel Airy, Augustus De Morgan, and Thomas Galloway. Even as this group was creating a new scientific world, in which the pursuit of Astronomy was a public enterprise, members of the Club were also regularly came together in the privacy of their homes. There they were joined by wives, sisters, and even girlfriends for dramatic productions, musical evenings and experimental demonstrations. In this paper I will explore the impact of this network of friends, this Club, on the development of science in the early nineteenth century.

Why Nuclear History is a Technocratic Narrative

Linda M. Richards

Abstract: The public discourse during the Fukushima accident included repeated reassurances that levels of radiation "below background" were harmless and implied that those concerned were irrational. Radiation health history, consent, and human rights are disconnected from popular nuclear discourse. Using secondary sources, interviews, and archival research from the Navajo Nation Museum in Window Rock Arizona, the Dwight D. Eisenhower Presidential Library, the University of Oregon Law Library, and the Oregon State University Ava Helen and Linus Pauling Special Collections, I argue that how nuclear history is told matters. It is not simply a successive series of controversies over nuclear power plants and fallout, but also a human rights struggle. Opposition to nuclear weapons was instigated before the bomb was ever used by the original scientists that created it. During the fallout controversy, scientists and citizens destabilized the belief that government authorities could objectively determine atmospheric radiation safety. Central to this mass education effort by non-government scientists was molecular biologist Linus Pauling, and his wife, Ava Helen, who worked to raise the

awareness of the cellular, molecular, and genetic effects of radiation. In particular, Pauling was lead plaintiff on the "fallout suits" from 1958 to 1964, an international effort to stop nuclear testing simultaneously in Britain, the US, and Russia. The initial response to Hiroshima and Nagasaki as well as the fallout suits link to today's resistance to further uranium mining on indigenous lands.

Weismann's Authoritarian Cell State

Lukas Rieppel

Abstract: Rudolf Virchow's cell-state metaphor provided 19th century physiologists with a remarkably powerful metaphor to understand the metazoan body. "Every animal presents itself as a sum of vital units," he wrote in *The Cellular Pathology*, "every one of which manifests all the characteristics of life." Hence, individual organisms are properly understood as "a kind of social arrangement." But exactly what kind of social arrangement? According to Ernst Haeckel, whereas plants may legitimately be likened to a republic, animals bear a far more striking resemblance to monarchic regimes. My paper explores what happened to the cell state metaphor in the wake of late 19th century discoveries about the cytological basis of heredity. In particular, I argue that Weismann's germ / soma distinction extended on Haeckel's vision of an authoritarian cell state. For Weismann and his contemporaries, among the most important unanswered physiological questions was how a homogenous fertilized egg gives rise to a highly organized individual made of many different parts, all of which must interact with each other in just the right way. Weismann's famous continuity of the germ plasm thesis postulated that a special substance--the Keimplasma--is passed on from parents to offspring, thus ensuring the transmission of organization between generations. In my paper, I argue that Wesimann articulated a remarkably brutal vision of how the Keimplasma enforces its will. He envisioned the metazoan body as a site of violence and competition in which pieces of Keimplasma compete with one another for mastery over the whole.

Drawing Line and Circles: The Conflicting Roles of Exactitude and Approximation in Mathematics

David Lindsay Roberts

Abstract: Since antiquity mathematicians have had complicated relationships with drawing instruments, even the most basic, such as the compass and the straightedge. Sometimes idealized instruments have been used to pose fundamental theoretical challenges, and at other times the practical limitations of actual instruments have been objects of intense scrutiny. An especially revealing episode occurred in Western Europe and North America in the nineteenth century, prompted by a surge of interest in mechanisms with which to draw straight lines. Initially emerging from eighteenth-century machine design problems, these "linkages" attracted both mathematicians and engineers. Research activity declined after a flurry of publications in the 1870s, after which mathematicians and engineers went their separate ways, but several enthusiasts in the first half of the twentieth century proposed using linkages for pedagogical purposes, with limited success. I will consider some reasons for the failure of linkages to take

hold in the schools, while briefly mentioning the revival of the subject as a topic of pure mathematical research in the late twentieth and early twenty-first centuries.

Unruly Technologies and Fractured Oversight: Developing a "Science" Based Approach to Chemical Regulation in a Risk Society

Jody Roberts

Abstract: Attempts to properly or appropriately or adequately govern synthetic molecules have faced two concomitant problems. These molecular technologies have proven unruly, presenting unexpected surprises that have challenged our ability to adequately reduce unwanted effects. That is, there is inherent scientific uncertainty in assessing risks. At the same time, our regulatory systems designed to manage these risks have faced devastating critiques for not operating from a sound scientific base. This situation has resulted in the perpetuation of a system of oversight and control fractured by geography, bureaucracy, and ecology – and further fractured by a system that scrutinizes one molecule at a time. The problems are compounded by the politicking that has typically interfered in the process of data acquisition to compensate for some of these uncertainties. This paper is interested in the exploring some of the outcomes of this predicament: attempts to scientize risk management to make it more "sound" and the tactics developed within regulatory agencies, exposed communities, and communities of scientists to develop novel sciences to compensate for the "undone science" within risk assessment. In particular, I'll be discussing the development of Structure Activity Relations (SAR) within the Office of Toxic Substances at the U.S. Environmental Protection Agency and the development and use of human biomonitoring by NGOs and the U.S. Center for Disease Control and Prevention.

Hans Pettersson and the Politics of Cold War Patronage

Peder Roberts

Abstract: While the Swede Hans Pettersson (1888-1966) is well known to historians of nuclear physics, this paper considers his career as an oceanographer. My goal is to provide a new window into a period of significant change in oceanography rather than to recover an intellectual legacy. The immediate post-war years are widely considered a boon to the discipline, thanks to an influx of state money. But there were losers as well as winners. In oceanography, as in other disciplines, power shifted from traditional centers in the Nordic countries to the United States. Many Europeans with cutting-edge research programs (in Pettersson's case, into the radium content of deep-sea sediments) were unable to keep up as funding opportunities increasingly drifted across the Atlantic. Pettersson felt that politically savvy – if intellectually unambitious – researchers came to dominate funding ahead of more 'maverick' figures, as an alphabet soup of institutions and committees emerged on behalf of various patrons, many of whom were interested more in surveillance and data-gathering. A frank correspondent, close to many European researchers who left Sweden for the United States, Pettersson also kept personal diaries (only now made available for study). I conclude with reflections on how Pettersson's career challenges historical narratives concerning the changes in oceanography from the late 1930s to the early 1960s, too often cast as a story of triumphant growth. This rising tide did not carry all boats.

The Copernicans and Prognostication: Continuities with Antiquity

Francesca Rochberg

Abstract: Francesca Rochberg will focus on Westman's discussion of the role of celestial prognostication in the "long sixteenth century" and draw out some continuities from antiquity concerning celestial signs and the interplay of astronomy with astrology that begin with the very origins of these sciences in the Near East and Western Mediterranean.

From Experimental Physical Chemistry to the Molecular World

Alan Rocke

Abstract: Hermann Kopp (1817–92) is today best remembered as a historian of science, but during his lifetime his experimental research was highly regarded. With his extended collegial circle of friends, his mastery of the contemporary and historical literature of the field, his important editing duties, and his fine judgment and work ethic, there was no more central personality for German chemistry in the middle decades of the nineteenth century. Moreover, Kopp pursued an extensive program of experimental research in physical chemistry at a time when physical chemistry was not yet a recognized field; indeed, his official appointment in Giessen as Privatdozent in 1841 was the first time the words "physikalische Chemie" appeared in an academic title. Kopp's appointment as Ordinarius at Heidelberg in 1864 was engineered by his good friend Robert Bunsen, and thereafter Kopp played a significant role in the development of the Heidelberg circle of experimental physical science. But his experimental work, influential as it was, failed to lead him to his desired goal of revealing the inner workings of the invisible molecular microworld. This presentation will propose reasons for Kopp's disappointment, and in the process offer reflections on the evolution of the rhetoric of scientific methodology in nineteenth-century German experimental science. To his chagrin, Kopp eventually found that the ideology of inductive science, so dominant during his student years of the 1830s, could not carry him to the profound goals he had set for himself.

Japanese Internment and the Science of Governing Dependent Peoples: Social Context and Scientific Truth

Karin Rosemblatt

Abstract: This paper examines the efforts of social scientists employed by the Office of Indian Affairs to understand leadership, public opinion, and community building among Japanese-Americans at the Poston, Arizona, internment camp during World War II. At the Poston camp, located on land owned by the Colorado River Indian Tribes, researchers introduced techniques developed the previous year for the Indian Personality Project (IPP), a research initiative exploring the effects of government programs on Indian acculturation and personality development. The IPP, which was carried out in eleven communities in the US Southwest, used an array of techniques culled from physical anthropology; anthropological culture and personality studies; psychiatry, psychology, and psychoanalysis; biology and medicine; and statistics. Alexander Leighton, a psychiatrist and lieutenant in the U.S. Navy who worked on the IPP, led the Poston research. There, scholars and research assistants sought to determine the

relation between aspects of personality and democratic self-government within the camps. John Collier, the US Commissioner of Indian Affairs, would later extend this research to Mexico and believed that in the post-war era it would be useful to US-occupied areas. This paper asks how this particular research trajectory consolidated social science concepts such as "minorities," "democracy," and "dependent peoples." How was scientific truth consolidated as techniques were applied across a range of contexts? By looking at the Poston experience, we also examine how the specific context in which social science experiments took place shaped both research techniques and findings regarding the relation of government to individuals and communities.

Kepler's Dialogue on Calendar Reform: Religion, Politics, and the Role of the Mathematician

Aviva Rothman

Abstract: Around the year 1604, Kepler drafted a dialogue—which he never published—focusing on the debate over the Gregorian calendar reforms and their adoption, a debate still rife in the Empire. In the dialogue, which featured a Catholic and Protestant theologian, a Catholic and Protestant politician, and a mathematician, Kepler proposed not the adoption of the Gregorian calendar, but rather a differently reformed Julian calendar. In this paper, I focus on both the form and content of Kepler's calendar dialogue. I argue that Kepler, like many of his contemporaries, saw the calendar dispute as a microcosm of the broader confessional discord dividing Catholics and Protestants. Still further, Kepler argued that the resolution of that dispute could provide a model for confessional reconciliation and for churchly unity more broadly. I also argue that Kepler used the issue of calendar reform and its resolution to articulate his conception of the proper social role of the mathematician. Specifically, he portrayed the mathematician as a vital mediator and conciliator, who through his craft provided not only a model of harmony, but also a resolution to the specifics of certain controversies which led to disharmony in church and state.

Environmental Consciousness in the Cold War: Radioecologists, Nuclear Technology, and the Atomic Age

Rachel Rothschild

Abstract: My paper will examine the emergence of ideas about environmental health and risk among the first ecologists to work for the Atomic Energy Commission from World War II through the naissance of the modern environmental movement in the 1960s. I trace the development of nuclear reactors and atomic testing alongside the attempts by these scientists to document the environmental impact of nuclear technologies, and examine the growing concern these 'radioecologists' began to articulate about the damage nuclear materials were posing to the environment. These were separate, though related, to fears about the human health risks of radioactive substances. I will demonstrate how these worries resulted in an increasingly fraught relationship between ecologists and the military, exploring the role of the military personnel in shaping ecological research and the concerns radioecologists had about Cold War policies. In addition, the paper will analyze the efforts by radioecologists to raise awareness about these dangers among policy makers and Congress, and show how their research affected the development of nuclear power, civil defense planning, and environmental policies. Additionally,

I intend to argue that the rise of radioecology is one part of a larger story that culminates in the transformation of "ecological" research into "environmental science," and that can help historians grapple with the intersection of the environmental social movement with science in the late 60s and early 70s.

The Parallel Lives of Two Viruses: Their Discovery and Reception

Neeraja Sankaran

Abstract: Cancer-causing viruses and bacteriophages may not at first glance seem to have more in common with one another and yet the two have had curiously parallel histories from the time of discovery until the 1950s when André Lwoff's work on the phenomenon of lysogeny gave the scientific community its first modern definition of a virus. Discovered within a few years of one another, the causative agent of tumors in chickens (in 1911) and the principle associated with inducing the lysis of dysentery-causing bacteria (in 1917), were both proposed as viruses – namely ultramicroscopic infectious agents of extracellular origins – by their discoverers. Despite the evidence put forward by each scientist in support of his theory, the large majority of contemporary workers in their respective research circles did not accept their claims and explanations, and the viral identities of both agents remained matters of contentious debates for many years. Although the research communities interested in these subjects did not intersect or communicate with one another at the time, many of the arguments used against the viral identities of the cancer agents and phages were remarkably similar in their lines of reasoning. By delving into the reception of, and reactions to, the ideas about cancer causation and bacteriophages, this paper, which paper is a first step in a broader project to explore the history of medical virology, aims at illuminating some of the governing biological and medical paradigms in the early decades of the 20th century.

Women as Information Intermediaries in Seventeenth-Century Southeast Asia

Matthew Sargent

Abstract: My paper traces the role of European trading networks as vehicles for gathering and exchanging scientific knowledge in Southeast Asia during the early modern period. My paper focuses on botanical and medical knowledge gathering by employees of the Dutch East India Company [VOC] in the Indonesian archipelago during the seventeenth century. It traces the evolving VOC efforts to gather naturalistic information, and demonstrate the importance of trading ties which crossed ethnic, social, and gender boundaries that might have otherwise hindered information exchange. European naturalists in Southeast Asia did not make their observations in a vacuum; their botanical and animal specimens were collected by local informants, and their diseases were often treated by local healers. I explore the ways in which foreign traders were able bridge social and cultural boundaries as they relied on local informants, particularly women, to collect information about the natural world. These local influences were particularly strong in the Dutch-controlled Indonesian archipelago, where colonists in the Indies had extensive contacts with the local population, many taking local wives. The depth of these ties were poignantly expressed in one instance by the Dutch naturalist Rumphius, who embedded a tribute to his wife and informant in his scientific text, "Since I have not been able to find either a Malay or an Ambonese name, I call it Flos Susannae in Latin, in Malay, Bunga Susanna

[Susanna's flower], in memory of her who, when alive, was my first companion and helpmate in looking for herbs and plants, and who was also the one who first showed me this flower." It is the story of these partnerships and exchanges that my paper seeks to recover.

Cosmological, Fragile, and Disembodied: Towards an Historical Epistemology of Chinese Medicine in Late Imperial and Contemporary China

Volker Scheid

Abstract: The Cartesian mind/body dichotomy in the history of Western thought is frequently contrasted with an essential holism underpinning Chinese thinking and practice, such as, for instance, in medicine. Yet, contemporary Chinese medicine physicians also claim to be able to understand and successfully treat biomedically-defined psycho-emotional disorders ranging from stress and tension to anxiety and depression. "Liver constraint" and "liver qi stagnation" are some of the most important illness categories around which this discourse is constructed. Indeed, resonant with the pandemic of psychosomatic illnesses sweeping the contemporary world, these categories constitute some of the most diagnosed patterns in Chinese medicine in countries as diverse as the United States and Taiwan. This paper will examine the processes of transformation in Chinese medical practice by which the cosmologically oriented body of Chinese medicine as constructed in canonical texts such as the *Huangdi neijing*, was successively transformed into a body that can accommodate to apparently dis-embodied states of mind. In particular, I will examine how the Liver came to be intimately attached to the illness category of constraint, which itself was gradually transformed from a concept describing pathologies caused by environmental factors to one describing primarily emotional disorders. I will attend to how conceptual transformations were linked to transformations of diagnostic practices and the redefinition of formula actions and indications in relation to specific historical contexts of practice.

The Incubation of Government Patronage in Medicine in Interwar America

Tom Scheiding

Abstract: The years between WW I and WW II represented a time of dramatic change in research patronage in medicine. The government’s approach to financing and managing medical research changed during the interwar era from minor to more active involvement partially because of the influence of one particular patron – the Chemical Foundation. The Chemical Foundation, popularly identified as an industrial philanthropist, during the interwar period organized the creation of and provided a significant endowment for the National Institutes of Health (NIH). As originally created, the NIH organizationally identified the government as the responsible agent for directing the research agenda in medicine. Financially the government financed public health activities and industry had the option to solve specific research problems through fellowships. This original setup of the NIH has been deemphasized in the scholarly literature with the consequence being that the emerging intellectual property considerations of medical research and the rapidly expanding research infrastructure in pharmaceutical companies after WW II have been overlooked. Rather than the NIH always and forever being devoted to public health with a complete reliance on government funding, the activities and financing of the NIH were negotiated by the CF. With extensive archival research it is found that the race to stake ownership claims over research by those in industry and their desire to organize their own

research laboratories rather than outsource the task to a newly-created government institution shaped the later structure, activities, and financing of the NIH.

The Crisis of Regulatory Scientists in Mutagenesis Testing (West Germany, 1970s)

Alexander Schwerin

Abstract: Chemical hazards became a major regulatory challenge for governments in Western industrialized countries from the 1960s on. The prevention of damage to workers and ordinary people from chemical contaminants in the environment raised a number of new problems, evident in the regulation of mutagenic hazards,. The assessment of chemical mutagenicity was more difficult than the assessment of the mutagenic threat by radioactivity and toxicity of chemicals, respectively. This involved both scientific and political problems. Hence, the problems of mutagen regulation shed some light on the co-production of regulatory knowledge and politics and the changing status of "regulatory science" (Jasanoff). This talk will examine the regulation of chemical mutagens in West Germany in the 1960s and 1970s. It will trace the scientific and industrial efforts in mutagenesis testing through an overview on the laboratories and the scientists involved, paying attention to their disciplinary background and the methods. The talk will focus then in more detail on the methodological questions that illustrate the key points in the debate. Beginning in the 1960s, an expert commission had been established to make policy and regulation recommendations. However, the commission failed in the end. The reason for this failure was not only ignorance of industry, but that there was no clear idea on mutagenesis testing. The proponents who argued for mammal-based test systems gained influence and financial support but could not present a final solution for the toxicogenetic testing dilemma. In the end, my analysis probes the effects of this crisis of regulatory practice.

Experimenting with Adulthood: Children's Toy Laboratory Kits and Popular Science Learning

Sarah Scripps

Abstract: During the politicized climate of the Cold War era, parents and educators sought to prepare children as future citizens through scientific training and exploration. Although historians have shown how Cold War educational policies altered the formal classroom instruction of science, the realm of popular learning at home remains largely unexplored. This presentation seeks to fill this gap by examining some of the most ubiquitous toys of Cold War era: science experiment kits. Ranging from chemistry labs to erector sets to "atomic energy" kits, these homemade labs brought the wonders of science back home. This paper argues that in order to understand changes in scientific learning occurring in the postwar era, it is necessary to study the home use of these popular educational toys. Targeted to a generation of children living amidst the permeation of science in mass culture, these toys reflected American faith in rationality and the promise of scientific discovery that were now accessible in children's own living rooms. By offering users a complex set of miniature laboratory equipment complete with classification guides and sample experiments, these toys emulated the professional world of science. Sciences and engineers added to this authority by writing in-depth instruction manuals, presenting step-by-step processes aimed at training the next generation of scientific minds. By

allowing children to play grown up roles, these science sets were aimed at inspiring a new generation of inventors, instilling hopes for an American future ruled by reason and innovation.

From Discovery to Production: The Curies and Artificial Radioactivity

Robert W. Seidel

Abstract: In 1932, Frederic and Irene Joliot-Curie discovered the induction of radioactivity in substances bombarded by alpha-particles. Their discovery opened up a new radiopharmaceutical industry, with Ernest Lawrence's cyclotron and Fermi's Rome laboratory seizing the opportunity to produce and provide a large number of radioisotopes for medical applications. Lawrence advertized his product as "artificial radium" and assigned members of the University of California Radiation Laboratory staff to investigate the radioisotopes of certain isotopes as they were made available by his increasingly powerful cyclotrons. The Rockefeller Foundation, as well as the Macy and Markle foundations, supported this research along with his experiments with neutron rays to treat cancer. My presentation will show how the radiopharmaceutical properties of artificial radioactivity came to rival those of radium, polonium and other elements made radioactive at the Curie Institute. The invention of the nuclear reactor by Fermi during World War II socialized isotope production in the Atomic Energy Commission, despite reservations by Commissioner Lewis Strauss about their export, and ironically led to the downfall of Lawrence's colleague and former Los Alamos director J. Robert Oppenheimer. These activities are part of a larger story of the science business in the interwar period which are developed in my forthcoming book on Technology Transfer from high-energy physics to the world. They reveal both the limits and the advantages of philanthropic investments in nuclear physics in the interwar period and the advantages and limits of government support for radiopharmaceuticals after the war.

Foundational Literature in STEM Curricula

David Sepkoski

Abstract: One of the challenges for integrating history of science into undergraduate STEM curricula is making a compelling case to colleagues in the sciences that historical study offers significant value for their students. Can we historians do more to offer classes that might help make history of science a more integral part of undergraduate training in the sciences? One possibility is the introduction of collaborative 'foundational literature' courses tailored for individual disciplines. It is often the case that advanced undergraduates and even graduate students in the sciences have had little exposure to some of the earlier, seminal literature in their fields. Foundational literature courses would give STEM undergraduates a more comprehensive grasp on the problems and questions that have motivated past inquiry in their disciplines, and would also make a compelling case for the continuing importance of historical perspective as students' educations and careers progressed. One important distinction between such a course and a standard history of science seminar is that foundational literature courses are imagined as an integral part of an STEM major curriculum, rather than as extracurricular 'electives.' In addition to discussing the practical and pedagogical reasons for pursuing this kind of collaborative teaching, this presentation will illustrate the mechanics of such a course using the example of a foundational literature curriculum for evolutionary biology.

The Prelude to the Galileo Affair, with an Eye on Campanella

Michael H. Shank

Abstract: This paper seeks to enrich our understanding of the context for Galileo's interaction with Roman officialdom in the 1620's and 30's. To do so, it examines the behaviors of Pope Urban VIII and the Roman censor Niccolò Riccardi toward Tommaso Campanella, his practices, and his writings. The sideways glance brings into sharper relief the divergent commitments of the two most important Church officials in the Galileo Affair, and highlights the tools they were prepared to use to reach their goals.

Nebraska, 1924: America's First Anti-Evolution Trial

Adam Shapiro

Abstract: In 1922, a schoolteacher in Nebraska lost his job offer to teach English at a Lutheran College. Members of the Lutheran Church in the small town where he had worked as school superintendent had written the dean a letter alleging that he was a believer in evolution, a denier of the Bible account of creation, and "morally and mentally unfit" to teach. In 1924, he won a civil lawsuit charging these parishioners with slander. In a country obsessed with questions of science and religion, the lawsuit brought by David Domer should stand out as America's first anti-evolution trial. Yet the case has hitherto been unknown. Historians have not discussed it, and the trial went unremarked by any newspapers outside of the state (as well as most in Nebraska.) In this talk I will discuss how this trial unfolded. I will also address the stark contrast between this case's obscurity and the 1925 Scopes trial, which gained international attention and continues to be one of the most famous events in US history. What does this contrast say about the way we think about the historical relationship between religion and science? What does it say about the way current debaters over the teaching of science use history to justify their positions?

Becoming Indiana Jones: Archaeological Training in the Classroom, 1900-1935

Kathleen Sheppard

Abstract: Although he rarely proved his point, Indiana Jones argued that "Seventy percent of all archaeology is done in the library. Research...reading." Like Spielberg's famous films, scholarly attention in the history of science also has focused largely on archaeologists' activities in the field. In the history of scientific education, recent scholarship has explored the site of the classroom and the role of teaching as gendered arenas, usually occupied by women. Therefore, studies in the history of archaeology tend to favor a heroic male fieldworker and marginalize the influence a female teacher may have had on the career of a "hero." This approach unfortunately eschews the work done by archaeologists in other academic areas, such as in the museum, in the library, and in the classroom. In fact, teachers, museum collections, and the classroom were crucial to training future archaeologists for their careers in the field, as collectors and teachers. This paper will highlight the classroom training of archaeologists from 1900-1935 by focusing on the Egyptology program at University College, London (UCL). I will explore part of the career of Margaret Alice Murray and her cohort who spent much of their careers training future well-known field archaeologists. I argue that it was her organization and consolidation of the first two-year training program in archaeology at UCL that produced the graduates who quickly

became famous field archaeologists in their own right. Therefore I argue that it is first the classroom, and not the field, where the "heroes" in archaeology are made.

The Origin of Life in the Cold War: Rehabilitating the Moral Complexity of the Miller-Urey Experiment

Matthew Shindell

Abstract: This paper examines the celebrated Miller-Urey experiment as a nexus of Cold War anxieties, funding opportunities, and research interests. Efforts to essentialize this experiment either as a nail in the coffin of creationism or as an example of atheistic naturalism run amok keep us from understanding the significance of the experiment during the time it was performed and from developing a more complex understanding of science and religion in Cold War America. In fact, this experiment was part of a larger research program devised and overseen by Harold C. Urey in a Cold War institution that he helped to construct. In addition to being built along the contours of the new postwar funding model, incorporating money from the Office of Naval Research, the Atomic Energy Commission, and the National Science Foundation, Urey's new research program also reflected the emerging concern of atomic scientists and their funders with the earth sciences. On the vanguard of the development of the new isotope geochemistry, Urey's own movement into the earth sciences was in part driven by the personal trauma of his wartime contributions to the Manhattan Project and by his own religious upbringing. Convinced that science had no moral or ethical norms of its own and that religion could not progress without incorporating an accurate and non-miraculous view of the universe, Urey's postwar research program complemented his public campaign for a modern synthesis of Judeo-Christian moral teachings with an accurate and inspiring view of man's place in the universe as provided by science.

Indian Science, the American Military-Industrial Complex, and the Creation of INSAT

Asif Siddiqi

Abstract: During the 1960s and early 1970s, a small but elite group of Indian physicists established the basic institutional foundations of a domestic Indian space program. The nascent "space" community employed three rhetorical strategies to couch the effort to the public, both as a way to insulate the effort from criticism and as a means to differentiate it from the major Cold War space programs of the Soviet Union and the United States. These characterizations of the program—the principle of self-reliance, the potential economic benefits to India's poor, and the peaceful nature of the effort—have remained inextricably linked to any public discussion of the Indian space program. In practice, the Indian space program embodied distinct counter currents to its constructed public identity. This paper looks at a critical phase in the early development of the Indian space program. In 1970, the Indian government commissioned a joint study project performed at from MIT's Lincoln Laboratory to study the feasibility of an Indian satellite. The INSAT project in both its tangible aspects and intangible dimensions represented a highly contested site involving frequently contradictory currents stemming from several sources: the professional aspirations of a rising scientific elite in India, foreign policy imperatives related to the Cold War, and nationalistic rhetoric that privileged the specificities of the post-colonial context. These contradictions provide a striking example of the kind of struggles (rhetorical or

otherwise) faced by scientific elites in specifically the Indian but also more broadly the post-colonial context during the Cold War.

Diplomacy and Science on the Eve of WWII: Arthur Compton's 1941 Trip to Brazil

Indianara Silva

Abstract: History literature traces the US efforts to bring Latin American countries to the Allies' side in the WWII well. After a time of hesitation and negotiation with both sides, the Brazilian government aligned itself with the US, which led to the US using air bases in the Northeast of the country, the creation of the Brazilian Expeditionary Force, and Brazilian fighting in Italy. Virtually unknown is involvement of science in these diplomatic arrangements. Recently unearthed material from the Arthur Compton Archives (by I. Silva at the Washington University Archives, Saint Louis) has shown that Compton's 1941 trip to a scientific conference on cosmic rays in Brazil was connected with the efforts led by the Office for Inter-American Affairs under Nelson Rockefeller. For Brazilian physicists, who had excelled in this area of research under the leadership of Gleb Wataghin in the late 1930s, science was a strong motivation for the visit however, it was not devoid of political connotation. The success of the political mission was testified by Rockefeller himself according to Compton in a letter to W. Jesse on May 11, 1942, "You may be interested to know that I had a discussion a few days ago with Mr. Nelson Rockefeller who told me that this expedition of ours, according to his reports, was the most successful one that had been undertaken thus far with regard to its stimulation of good relations between the Americas". Our paper analyzes this interface between science and politics.

The Agronomic and the Anthropological: Two Modes of Representing People in Nineteenth-Century France

Dana Simmons

Abstract: In this paper I suggest that in nineteenth-century France there were two primary modes of representation in the human sciences: the agronomic and the anthropological. The former is characteristic of chemists and physiologists; the latter of social reformers and economists. Both modes of representation closely linked the human and the natural sciences, though measurement and numbers. The agronomic subject is a chemical body, apprehended and known by its weight and chemical composition. It is part of a globally circulating quantum of matter, which enters the body and leaves it in turn. In other words, an input-output device. Weight - the scale balance - measures the equilibrium of the body with respect to its environment. Fluctuations of weight from a base level indicate dysfunction and/or improper maintenance. The agronomic subject does not create anything, but transforms what it ingests; it loses and replaces its own matter constantly. The anthropological subject is a 'sample' of an already clearly bounded group. Numbers are used to apprehend and describe it, most prominently the sample family budget. Indeed, the anthropological subject is overburdened with numbers of all kinds, corresponding to multiple forms of social activity, production and consumption. The usual unit of analysis is the family, which is taken to represent a social class and/or race. The anthropological subject thus is grounded on and presupposes both class and gender differentiation.

Halley Turns Republican. How the Portuguese Daily Press Perceived the Return of Halley's Comet in 1910

Ana Simões

Abstract: Based on a comprehensive survey of all news on the return of Halley's comet in 1910 as seen by three daily generalist Portuguese newspapers (Diário *de Notícias, Comércio do Porto and Diário dos Azores*), we offer a comparative assessment of the cultural meanings of Halley's passage in different local settings. The newspapers were chosen on the basis of their wide circulation, broad ideological scope and different geographical locations. Although similarities among all newspapers may be associated with international trends and the perceived role of foreign popularizers such as Camille Flammarion, the importance of "locality" in shaping different appropriations of Halley's passage is particularly clear in the reports of journalists, in the news written by Portuguese scientists or in the participation of the public, a quite unexpected phenomenon in view of the high illiteracy (80%) of the Portuguese population. Scientists often used the daily press to engage in the popularization of science, partaking in this way the ideal of the republican movement whose positivistic orientation presented science as an antidote to religion and superstition, and as a means to educate the people and to modernize the country. Their articles served their local agendas. Many turned Halley into a republican comet, a celestial spokesman of a political movement that successfully replaced the monarchical regime on 5 October 1910, just four months after it vanished from the sky.

The Fortunes of Critiquing Objectivity: Consensus and Objectivity amongst the Atomic Scientists, 1945-1955

Patrick Slaney

Abstract: Even within the physical sciences, many mid-century American scientists did not emphasize objectivity in their understanding of scientific practices. Rather, drawing from the intellectual and political upheavals of the 1930s, they saw close connections between democracy and science as a social process oriented towards consensus. Thrust into the realities of American politics following the atomic explosions of 1945, concerned American scientists attempted to live up to their belief in the link between science and democracy as they campaigned for the civilian control of atomic energy and the international control of atomic weapons. The centrality of discursively produced consensus, rather than of objectivity, in scientists' understanding of science affected the manner in which they participated in the American public life. Largely because of their emphasis on consensus and unanimity even activist scientists, such as Eugene Rabinowitch, Charles Coryell, and William Higinbotham, were reluctant to speak as scientists without waiting for broad consultations with their fellows. Neither politics nor the public sphere had the patience required for rituals of consensus formation. Nor, increasingly, could scientists come to a consensus, even about such apparently factual issues as the dangers posed by atmospheric atomic tests, let alone how best to limit nuclear proliferation. The immediate post-war episode is important, however, because in presenting the difficulties faced by scientists participating in the public sphere without making explicit recourse to a rhetoric of objectivity, we can see some of the appeal that such a rhetoric would have as the Cold War itself developed.

Refusing to Give Up the Ghost: Robert Chambers, Materialism, and Religious Sensibility in Victorian Britain

Angela Smith

Abstract: Among the holdings of the National Library of Scotland is an unpublished manuscript that Robert Chambers began composing in the 1850s defending his belief in spiritual entities. Based on what he considered valid empirical evidence, Chambers concluded that the existence of spirits was not in conflict with modern science, and he presented evidence that the human personality survived corporeal death in a way that he hoped would be persuasive to proponents of 'liberal philosophy.' Although virtually ignored by historians, Chambers's *Spiritualism* manuscript represents one significant manifestation of the many efforts to integrate science and religion during the second half of the nineteenth century. Chambers's most famous work, *Vestiges of the Natural History of Creation*, which had been anonymously published in 1844, figured heavily in public skirmishes in the decades after it appeared, with many critics charging that it was a materialist abomination. Yet Chambers never saw his development theory as conflicting with his religion, and he defended Vestiges from attacks by what he saw as religious extremists and scientific dogmatists alike. While some historians have joined contemporary critics in interpreting Vestiges as a materialist production, I argue that it was only one chapter in Chambers's persistent attempt to reconcile science and religion, with the Spiritualism manuscript representing another. The séance allowed Chambers to bridge the gap between his religious and naturalistic commitments. Spiritualism provided those like Chambers who were struggling with the materialist implications of their own philosophies empirical reassurance of some of the most cherished tenets of revealed religion.

The Second Living Room: The Science Behind the New Soviet Kitchen, 1959-1980

Jenny Leigh Smith

Abstract: This paper explores the retreat from the scientific kitchen as it was experienced in the Soviet Union during the later Cold War. While the sciences of food processing and nutritional research became even more firmly grounded in the laboratory during this period, the home kitchen transitioned into a kind of informal second living room. This paper explores how and why the kitchen as laboratory was quietly retired between 1957 and 1980 in the Soviet Union and it describes the uniquely Soviet aesthetic that helped the Soviet kitchen evolve into a private and trusted social space. In this paper, I discuss the form and function of the newly informal kitchen culture of the Soviet Union and I describe the delicate balance that was struck between this more personal Soviet kitchen and the increasingly sophisticated, state sponsored sciences of food processing and nutritional research. I argue that these more mundane "behind the scenes" sciences were critical factors that allowed domestic sites of consumption to become more personal, convenient and welcoming. Lastly, I argue that the kitchen was one of the Cold War's most telling home fronts. After the 1957 Kitchen debate between Vice President Nixon and the Soviet Premier Nikita Khruschev, the Soviet state and its citizens consciously redefined the Soviet kitchen to more accurate reflect the values and priorities of Soviet citizens. While this was not necessarily a collaborative effort, both personal and official actions contributed significantly to this endeavor.

Evolutionary Naturalism and the Study of the Nebulae

Robert W. Smith

Abstract: Historians who have interested themselves in the history of astronomy in the late eighteenth and the first half of the nineteenth century have generally been little concerned with evolutionary naturalism. In part to bring together the history of astronomy and evolutionary naturalism, I will examine the schemes of development of nebulae that were advanced in this period, as well as explore the broader reception of these schemes and their use by popularizers of science on Britain. In particular, I will examine the place of the nebulae in what has been called the "evolutionary epic" first advanced in coherent fashion by Robert Chambers in his now infamous _Vestiges of the Natural History of Creation_ of 1844.

A Search for Perspective: Project OZMA and the Drake Equation

Sierra Smith

Abstract: The first scientific search for extraterrestrial intelligence (SETI), Project OZMA, was undertaken by the National Radio Astronomy Observatory (NRAO) in 1960 during a period of increasing tension between scientists and the federal government. Many scientists were becoming increasingly vocal about their apprehension to the arms race, the Cold War, and the use of science in furthering the national security state. Frank Drake, the architect of the project and a leading figure in later SETI projects, envisioned SETI as both an important area of scientific research and as a way to develop a new perspective on humanity's place within the galaxy. Whereas the dominate ideology of the Cold War was one of an antagonistic, fearful competition with the Soviets, Drake and his colleagues, such as Carl Sagan and A.G.W. Cameron, argued that a shift in priorities towards SETI projects would allow humanity to grow out of its dangerous technological adolescence. Recent scholarship on scientists' reaction to the Cold War and the MIAC, such as Jessica Wang (1999) and Kelly Moore (2008), has focused on scientists as political actors. By contrast, the effects of the period on scientists' professional work is just beginning to be examined. This paper will focus on the development of Project OZMA, its theoretical underpinning, the Drake Equation, and the first SETI conference at the NRAO in 1961 as a way to illuminate the multiplicity of responses in the scientific community to the debate over the relationship of science and the federal government during the 1960s.

The Philosophical Breakfast Club and the Invention of "The Scientist"

Laura J. Snyder

Abstract: In 1812, four remarkable men met at Cambridge University: Charles Babbage, John Herschel, Richard Jones and William Whewell. They began to meet for breakfast Sunday mornings after the compulsory chapel services at their respective colleges. At these "philosophical breakfasts," they would often read a passage from Francis Bacon's work, and discuss the need for a new Bacon-influenced scientific revolution, one which privileged an evidence-based, inductive method of discovery, and one which asserted the need for science to serve the public good. In my new book, The Philosophical Breakfast Club, I follow the intertwined lives and works of these men over the next 60 years, and argue that by the end of

their lives they had succeeded, even beyond their wildest dreams, in bringing about a scientific revolution. What I will discuss in this paper is one aspect of the revolution they wrought: the shift from the amateur natural philosopher to the professional scientist, from the country curate collecting fossils or beetles in his spare hours, or the industrialist studying bleaching of flax to help in his manufacture, to the scientist, trained at the university, with membership in specialized societies, publication in specialized journals, who was eventually even able to make a living as a scientist. It is indicative of their intent and their results that a new name, "scientist," was needed for this new creation—and that it was invented by one of the four, Whewell.

Visualizing Users: The Power of Alternative Methods for Developing Historical Narratives

Christy Spackman

Abstract: Understanding how producers imagine users of products is complicated, but especially so under historical circumstances. My current project seeks to understand how producers have imagined users of industrially-produced functional beverages, drinks that blur the typical boundary between food and medicine. It utilizes a range of methods that are fairly common in historical analysis such as content analysis, semiotic analysis, and discourse analysis. By examining the textual and visual aspects of food packaging, we can gain a deeper understanding of how producers imagine their users; text and image are combined on packaging to create powerful messages linking food with health and individual responsibility. Yet not all functional beverages were found in all neighborhoods, reflecting space limitations, lack of belief in the product on the part of distributors and retailers, and/or beliefs by producers that a beverage did not fit a given market. Hence this project also combines more traditional techniques described above with others borrowed from the social sciences and elsewhere, including GIS (to map product sale locations within New York City) and comparing product pricing and availability with neighborhood demographics. When combined with visual and textual analyses relating to the products available, a clearer picture of the imagined user emerges. Although this multidisciplinary methodological approach is especially powerful when used in a contemporary setting, application of this approach to historical research opens up new avenues for understanding historical relationships between producers and consumers. The paper explores the potential for using such techniques particularly for food-related research in history of science.

Mme Curie & Albert Einstein in 1911 and 2011: A Friendship in History & Memory

John Stachel

Abstract: The paper examines the friendship between Mme Curie and Albert Einstein circa 1911, a key year for both, for professional as well as personal reasons. The paper also examines how the scientific community had marked the respective Centennials of their main discoveries in 1998 and 2005, and inquires into the role of disciplinary and gender differences in these commemorative patterns.

The First German Genetics Institute 1914-1930 a "Damenstift" (Foundation for Noble Nuns)

Ida Stamhuis

Abstract: The high number of female staff involved in early genetics research and investigations into radioactivity (1900-1930) in many countries is striking. In my paper I will focus on the first German institute of genetics, which was founded in 1914 at the Agricultural College in Berlin under the directorship of Erwin Baur. During the whole period of his directorship women constituted the majority of the scientific staff: five of the six staff were female. By 1927 the institute had gained an international reputation and played a central role in the 5th international genetics conference, held in Berlin. In 1928 a potential successor of Baur caricatured the institute as a 'Damenstift'. The nature of the institute prompts a number of interesting questions, which may be discussed to greater or lesser extents depending on the predominating interests of the session. Some issues worth considering include the kind of leadership Baur exerted and the strategies he employed to facilitate the institute's growth. Also, how did this institute gain a reputation in the international genetics community and in the German scientific community? Did a gender division of work exist within the institute? And what role did Baur and more generally the institute play in the careers of the individual members, female as well as male?

The Moral Benefits of a Science Education: Huxley, Maxwell, and the Working Men's College

Matthew Stanley

Abstract: T.H. Huxley and James Clerk Maxwell, two pivotal Victorian scientists with quite different sociopolitical outlooks, were both closely involved with a peculiar educational institution, the Working Men's College. Originally founded by the heterodox theologian F.D. Maurice as part of the Christian Socialism movement, the school emphasized the importance of science education for its moral benefits to the lower classes, rather than the practical benefits emphasized by similar institutions. This point attracted both Huxley and Maxwell to work there as instructors despite their powerfully opposed viewpoints on class, religion, and the future of British society. They were drawn to the importance of science education as a vehicle for the moral improvement of students, and stressed the value of learning science for the effect it had on their mind and character. Maxwell and Huxley were highly influential figures in shaping science education in Victorian Britain, and here we can uncover a neglected root of the values that drove that work. The Working Men's College was a site where Huxley's egalitarian agnosticism found common ground with Maxwell's aristocratic evangelicalism: two very different agendas that both promoted the moral value of science.

Bel Canto Refracted: Laryngoscopy in Nineteenth-Century Vocal Practice

Benjamin Steege

Abstract: This talk focuses on a brief but productive collaboration around 1860 between Emma Seiler and Hermann von Helmholtz, voice teacher and physiologist respectively, which set an early precedent in extending the recently introduced medical practice of laryngoscopy to all aspects of singing. Seiler's resulting publications witness a remarkable proliferation of detail

concerning management of the vocal organs, particularly the control of vowel quality and registral breaks. Yet the sheer fact of such voluminous detail posed a distinct challenge to both teacher and student, who, as Seiler emphasized, now assumed an unfamiliar self-consciousness. Defamiliarizing awareness of one's person was made literal in the case of the corollary practice of "autolaryngoscopy," in which singers were meant to observe their own larynxes while singing. Thus, where Helmholtz marveled at the precision and efficiency of the vocal apparatus as seen in the instrument's tiny mirror, Seiler contrastingly pointed up the novel sensations of resistance and fragmentation produced in this regimen. These complementary responses to laryngoscopy are typical of a range of contemporaneous disciplines of aesthetic practice that might best be described as "protomodernist" in their conflicted commitment to an analysis of bodily practice that aims, but constitutively fails, to transcend the fragmentation resulting from some local technique.

Four Versions of The Sphere Eversion: Modeling Topological Theories in Multiple Media

Alma Steingart

Abstract: In 1958, future Fields medalist Stephen Smale shocked the mathematical community by proving that, topologically speaking, one can turn a sphere inside out. In mathematical terms, Smale proved that there exists a regular homotopy between the sphere and its eversion in three dimensions. However, the proof did not suggest any clear procedure for ascertaining what such an eversion might look like. Ever since, mathematicians have struggled to visualize explicit eversions in myriad ways, from pencil sketches and color illustrations, to wire, clay, and plaster models, to computer illustrations and no less than three animated films. The desire to visualize an explicit eversion signals the various kinds of engagements mathematicians seek in their everyday practice. Following and comprehending Smale's abstract proof was for them only one way to grapple with the sphere eversion. Constructing it was another. Representational tactics were marginalized for most of twentieth-century mathematics. In this paper, I argue that the problem of the sphere eversion exemplifies an historical shift in the late twentieth century toward a more visual approach to mathematical research and pedagogy. Since explicit eversions have been constructed in diverse mediums, the problem provides one place from which to examine mathematicians' ongoing negotiation between abstract and concrete, and formalizable and visualizable, modes of knowledge. The history of the sphere eversion problem makes evident that as mathematical practice changed at the end of the twentieth century, so did mathematical epistemologies.

Between the Clinic and the Couch: Genetic Counseling and Human Genetics

Alexandra Stern

Abstract: How did Americans learn about developments in clinical genetics and their potential impacts on their lives and future? This talk will explore the emergence of genetic counseling, from the 1940s to the 1970s, as a unique field that combined scientific knowledge, risk assessment, and psychoanalytical approaches. How genetic counseling incorporated these components had important implications for the communication and possible miscommunication of genetic information. For example, strong reliance on Carl Rogers' theories of client-centered therapy, on one hand, and rational choice models of decision-making, on the other, fortified but

also limited genetic counseling. This talk will shed light on a largely overlooked historical dimension that has had ramifications for how patients, clients, and inquiring Americans have understood the promises and perils of human genomics.

Stem Cells and the Colonial Metaphor

Hallam Stevens

Abstract: Biological cells have often been compared to factories. In talk and writing about stem cells, however, the predominant metaphor is that of the 'colony': aggregations of stem cells become imperial outposts from the metropolitan body. Although the notion of a bacterial 'colony' has a long history in cell biology, this paper argues that this metaphor has special salience for stem cells. Reading accounts of stem cells by scientists, journalists and policy makers, this paper will show how the colonial metaphor plays an important role in shaping our understanding of these objects. First, the colony is a metaphor of conquest; colonies are vectors of territorial expansion. The colonial metaphor is used by stem cell scientists and advocates to suggest the importance of stem cell research as 'frontier' science. Second, colonies, like factories, are spaces of economic production. Stem cell colonies and stem cell 'lines' (the other metaphor commonly used to describe collections of stem cells) are described as places for the production of valuable therapeutic agents. Finally, the colonial metaphor informs how we understand the relationship between biological parts and wholes. Colonies are both physically remote and yet also integrated into a 'commonwealth.' In becoming colonies, stem cells are able to remain part of the body while simultaneously remaining apart from it.

Beyond Model Organisms: Bringing Biodiversity in the Test Tube

Bruno J. Strasser

Abstract: Model organisms played a central role in the rise of the experimental life sciences in the twentieth century. Researchers expected that the results obtained from experiments performed on these select species would be valid for a wide range of organisms. This "exemplary" approach of experimentalists contrasted with the "comparative" approach so prevalent in natural history, where researchers produced general knowledge by comparing features from numerous species. Yet, some of the greatest successes of the experimental life sciences, including in molecular biology, also relied on comparative approaches and studies of diverse groups of organisms, to a much greater extent than has been recognized by historians. The reliance of experimental biology on comparative methods entailed challenges for which experimentalists were rather unprepared. Laboratories, unlike natural history museums, did not have extensive networks of collectors and laboratory researchers generally had no experience of field collecting. This paper shows how experimentalists overcame these challenges and discusses the unique epistemic role that comparative studies have played for the production of experimental knowledge. Finally, it argues that the convergence of the "exemplary" and "comparative" approaches constitutes one of the defining historical transformations of the life sciences in the twentieth century.

Fire-Illness: Globalized Psychiatry, Nationalized History, and the Korean Effort to Make the Local Visible

Soyoung Suh

Abstract: Depression has become a significant problem in Korea, just as it has elsewhere. Paralleling popular and professional discourses on Koreans' dysphoria, Fire-illness has gained currency in contemporary Korea. Based on the sentiment of "Han," the presumably Korean way of feeling accumulated resentment and frustration, Fire-illness has been identified as an indigenous mental problem and registered as a uniquely Korean culture-bound syndrome by the American Psychiatric Association in 1994. This article scrutinizes this process of making Fire-illness an internationally recognized term for Koreans' anxiety, anger, and obsessions. Then, it demonstrates how inextricably conceptions of Koreanness in medicine have been tied to the right positioning of Korea in a global context. Fire-illness at its core presents the Korean fear of constraint, both medically and culturally. It first gained traction with the medical community in the 1970s, when both Korean psychiatrists and doctors of traditional medicine produced a series of studies on Fire-illness. These efforts were in many ways an extension of work that had started in the Japanese colonial period in the 1930s. Fascinated with Korean distinctiveness, Japanese and Korean doctors began exploring local culture in medicine and documenting a series of bodily traits that offered ethnic contrast and comparison. The 1930s' management of the locality in medicine is compared with the 1970s' interest in Fire-illness in order to reflect on the (dis)similitude of Korean fear of constraint and their incessant desire to expand their global reach, both epistemologically and geographically.

Natural History in Transition

Mary Sunderland

Abstract: While natural history floundered during the twentieth century in some places, it thrived at Berkeley's Museum of Vertebrate Zoology (MVZ). Founded in 1908, the MVZ sustained its core research program through a transformational period for the life sciences and emerged as an established leader in a variety of research areas, including evolutionary genetics and bioinformatics. By looking at work at the MVZ during a transitional period in the 1960s and 1970s, this paper examines the incorporation of new techniques and approaches to working with collections, including: physiology, biochemistry, cytogenetics, starch-gel electorphoresis, comparative immunology, and the computerization of data. During this phase of technological change, the MVZ experienced a transitional period of leadership. Between 1965 and 1971 the MVZ had four directors: Alden Miller, an ornithologist; Aldo Starker Leopold, a conservationist and wildlife biologist; Oliver Pearson, a physiologist and mammalogist; and David Wake, a morphologist, developmental biologist, and herpetologist. Four directors in just over five years is a striking amount of change. Juxtaposing the work of each director shows what it meant to be a naturalist during this period and offers insight to the changing identity of natural history.

Scientists under Pressure: The Scientific Practices of a Cold War Underwater Laboratory

Nellwyn Thomas

Abstract: In 1969, the U.S. Office of Naval Research, Department of the Interior, and NASA placed four marine biologists at the bottom of the sea for sixty days. From their habitat fifty feet below the surface, these marine biologists had the rare opportunity to conduct in situ field research on the coral reefs of the U.S. Virgin Islands. While these "aquanauts" undertook their studies of marine flora and fauna, they were themselves the subjects of a different experiment. On shore, another team of scientists monitored the aquanauts twenty-four hours a day—part of a study of the psychological and physiological effects of an "isolated and hostile environment." The Tektite Project, with its layered spaces of inquiry—an underwater field site, underwater laboratory and on-shore laboratory—was a literal manifestation of what Robert Kohler has called the co-evolution of laboratory and field science. This paper analyzes the Tektite habitat as a polyvalent space and these marine biologists as liminal actors who negotiated their roles as both scientists and subjects. It also examines the nested practices of knowledge production in the underwater habitat, tracing the flow of scientific data from the seafloor to the habitat, up the support cables and into on-shore labs, and finally out into scientific journals.

Building the Pharmaceutical Workforce and the Post-War Pharmaceutical Enterprise

Dominique A Tobbell

Abstract: In the decade after World War II, leading pharmaceutical companies established nationally organized, competitive fellowship programs. This reflected a new strategy adopted by industry leaders to shape the political economy of pharmaceutical research. With the Federal government the new principal patron of basic biomedical research, drug companies, medical schools, and the scientific leadership came to realize after the war's end, the cost of biomedical education and training was increasing without a concomitant increase in support from the Federal government. Moreover, these groups worried that greater government support of training and education would represent a move toward socialized education and socialized medicine. Industry and biomedical leaders were also concerned about an impending workforce shortage in the biomedical sciences in general, and in pharmaceutical-related fields in particular. After all, the innovativeness of the drug industry was dependent on a continuous supply of skilled pharmaceutical knowledge workers—skilled laboratory technicians and Ph.D. researchers in organic and medicinal chemistry, biochemistry, pharmacology and other fields related to drug development. This paper argues that the industry's commitment to developing the post-war pharmaceutical workforce constituted an industry-academic-government network that paralleled the emergence of the military-industrial-academic complex. In the post-war decade, this pharmaceutical network produced scores of new therapeutic agents, supported the development of pharmaceutical-related fields of science and medicine, especially that of clinical pharmacology, and played a crucial role in preserving the political interests of the industry and medical profession, and of establishing the pharmaceutical industry as one of the most powerful interest groups in American politics.

Natural History at the Turn of the Century

Jenna Tonn

Abstract: In the United States the period between the founding of the Museum of Comparative Zoology (MCZ) by Louis Agassiz in 1859 and the completion of African Hall at the American Museum of Natural History by Henry Fairfield Osborn in 1932 is often referred to as the Golden Age of natural history. It was a time when the natural history museum emerged as a powerful institutional structure for American science – funding research in botany, zoology, and geology at home and abroad, providing training and professional opportunities for an increasing number of naturalists, and establishing major specimen collections for study and display. Yet it is often said in the history of biology that the natural history museum was eclipsed beginning in the 1880s with the rise of the experimental work in university laboratories. As a result the museum increasingly became associated with the public education of science to the detriment of its scientific prestige. Nevertheless experimental laboratories were designed, constructed, and utilized in natural history museums during this time period. By examining the changing practices of naturalists within specialized research spaces in the MCZ, this paper will suggest that beginning in the late nineteenth century the American natural history museum increasingly became a heterogeneous space of inquiry (e.g. laboratories within museums) and one which produced hybrid ways of knowing (e.g. physiological zoology).

The New Alchemy Institute: A Countercultural Alternative to Big Science, 1969-1980

Henry Trim

Abstract: My research investigates the symbiotic relationship between science and the counterculture of the "long 1960s" in North America. This paper examines the criticisms that one group of scientists, the New Alchemists, levelled against the "big science" of the post-War era and it analyses their efforts to develop an alternative to big science through the use of citizen scientists. In 1970 two biologists from the Woods Hole Ocean Oceanographic Institute in Massachusetts founded the New Alchemy Institute. Deeply concerned about the pollution and dependency caused by industrial agriculture and committed to countercultural ideals the New Alchemists and worked closely with the organic foods and back-to-the-land movements. As scientists, they were particularly concerned by the control corporate agriculture exerted over science. They argued that corporations were deceiving Americans by assuring them that chemicals and hybrid crops would continually increase yields and by glossing over farmers' growing on corporate science and the mounting environmental damage associated with industrial agriculture. To combat these problems, the Institute began a program of countercultural science. It enlisted the assistance of people across America as citizen scientists in an attempt, not only to put organic agriculture and aquaculture on a firmer scientific footing, but also to construct a form of science that was both democratic and responsive to the needs of "the people". My analysis of the New Alchemists' vision of an alternative form of science demonstrates the centrality of scientists to the criticisms of science mounted by the counterculture and the organic movement during the "long 1960s."

Sword, Shield and Buoys: Exploring the History of the NATO Sub-Committee on Oceanographic Research, 1959-1973

Simone Turchetti

Abstract: Following the launch of Sputnik in 1957, NATO inaugurated a major effort to increase the funding of collaborative research within (and between) its own member states. One of the first initiatives taken by the newly-established NATO Science Committee, in 1959, was a specific sub-group devoted to sponsoring and organizing novel research in oceanography. This paper explores the history of this sub-committee, charting its trajectory in the fourteen years of existence. I show that its foundation responded to a perceived need for oceanographic data from areas of potential military-strategic significance, such as the Mediterranean and the North Sea. This included funding for a range of activities, embracing the development of new instruments and theories as well as building scientific 'capacity'. I also scrutinize the reasons that led the to committee's dissolution, focussing in particular on its shortcomings. In particular, I see the dissolution as mapping onto a more profound shift in science policy-making that led NATO planners to place greater strategic emphasis on the solution of environmental problems.

Why Routine Forecasting Practices Matter

Roger Turner

Abstract: This paper explores how routine forecasting practices change in response to changes in scientific theory, arguing that forecast users play a more powerful role than is generally thought. It examines the United States Weather Bureau during the second quarter of the 20th century, as two socially distinct groups struggled to control the federal government's meteorological bureaucracy. Weather Bureau records reveal a welter of prosaic disputes about routine work: How should preprinted forms be designed? How often did observations need to be taken and forecasts issued? What weight should academic training carry in personnel promotion? The paper argues that underlying these mundane questions was a deep disagreement over how to best know the weather. Advocates of "isobaric geometry," an established forecasting technique dating to the 19th century work of Robert FitzRoy and Cleveland Abbe, developed an intuitive, experiential weather knowledge mediated through synoptic mapping. Bergen School meteorologists, trained in dynamics by Vilhelm Bjerknes and his students, understood the weather as a three dimensional, geophysical phenomena, with their knowledge mediated through equations and, ultimately, digital simulations. These disagreements came to a head as a result of the development of aviation, when the Bergen School's close ties to airlines and naval aviation gave it powerful political backing to implement changes in the day-to-day work of the Weather Bureau.

Laws of Biology in Orthogenetic Theory

Mark A. Ulett

Abstract: Historians and philosophers of biology have debated the role of "laws in biology" repeatedly for the past several decades, while evolutionists have employed this notion with fewer reservations. For example, at the turn of the twentieth century, orthogenesists used different notions of "laws" prominently when constructing their theories of evolution in definite directions

due to limitations on variation. These orthogenetic laws are often seen as an expression of more general attempts to find historical generalizations or patterns of history, which were widespread during this time. In this paper I will show that this view does not hold up to scrutiny. Orthogenesists as diverse as Theodor Eimer (*Organic Evolution*, 1890), Henry F. Osborn (*The Origin and Evolution of Life*, 1917), and Leo Berg (*Nomogenesis*, 1922) employed a concept of laws in biology that does not see those as merely historical generalizations. Rather they focused on internal or structural mechanisms as the cause for the observed patterns of evolution. The orthogenesists were thus committed to a conception of law more akin to the laws of physics than to teleological laws or historical generalizations. These theories do not fit neatly within the dichotomy of evolution as either historically descriptive or mechanistic, as described by Ernst Mayr. I argue that many orthogenesists attempted to integrate these conceptual approaches into a comprehensive theoretical system.

Protection against Nightmares: Talismans and Ritual Exorcist Techniques in the Late Ming Encyclopedia *Forest of Dreams*

Brigid E. Vance

Abstract: This paper explores the medicalization of dreams and nightmares, viewed through the lens of the 1636 encyclopedia, *An Explication of the Profundities in the Forest of Dreams* (夢林玄解; hereafter Forest of Dreams). In addition to cataloging and organizing nearly 5,000 dream examples from the dynastic histories, *Forest of Dreams* also provided readers with practical solutions for self-healing. In the twenty-eighth *juan* (or volume) of *Forest of Dreams*, compilers presented twenty-five images of talismans, accompanying incantations, and related advice aimed either generally at ensuring a good night's sleep, or specifically at offering protection against the deleterious effects of inauspicious dreams or nightmares. The encyclopedic compilers assumed the possibility of self-healing on the part of encyclopedic readers. Readers could simply choose the appropriate talisman and its accompanying incantation in order to protect themselves from their dreams. My emphasis in this paper is not on the dreams or nightmares themselves, but rather on the ways in which these were manipulated and imbued with meaning by the literati compilers. *Forest of Dreams* not only offered compilers and readers a means to comprehend the world of dreams, but also the methods necessary to escape a world of nightmares. An analysis of the exorcist techniques and methods contained in this encyclopedia offers insights into the history of medicine in late imperial China, revealing intersections between nightmares, health and healing, and visual culture.

A Baroque Sensibility: Spectacle, Public Demonstration, and Ambiguity in Early Modern Science

Mark A. Waddell

Abstract: In the 2008 Sarton Chair Lecture, Jens Høyrup argued that the "Baroque mindset," with its emphasis on ambiguity, probabilism, and sensualism, was incommensurable with the "new science" of the seventeenth century. Baroque imagery -- printed on the page as well as enacted publicly in displays of spectacle -- may indeed have embodied ambiguity and probabilism, as Høyrup suggests, but these characteristics were also central to contemporary debates in natural philosophy. Athanasius Kircher, for example, used spectacle and public

demonstration to highlight the problems of uncertainty and sensual fallibility, just as earlier thinkers such as Federico Cesi and Galileo Galilei had confronted the serious epistemological problems inherent in the production of images as well as the use of technologies like the telescope and microscope. If, as some have suggested, baroque art and culture occupied a middle ground between the ideals of harmony and order on the one hand and, on the other, the stark reality of an ambiguous and mysterious cosmos, the same must be said of European science as it developed in the latter decades of the seventeenth century. To describe an increasingly ambiguous and mechanistic universe, proponents of the "new science" turned to ever more inventive, sensual, and public ways of displaying their philosophy, retracing the steps made earlier in the century by those, such as Kircher and Cesi, who were enmeshed in Høyrup's "Baroque mindset."

Wagering on Silver: Science and the General Welfare in the German Mines

Andre Wakefield

Abstract: Major figures including Leibniz, Alexander von Humboldt, Novalis, and Goethe devoted thousands of hours to improving and administering silver mines. On the whole, scholars have treated their efforts as straightforward Enlightenment attempts to harness science in the interest of the general welfare. Alternatively, in the case of the German Romantics, the mines appear as a source of mystery and inspiration. But the German silver mines were not what they seemed to be. Most of them did not turn a profit, so that investors were forced to pay "contributions" to keep failing mines afloat. Sometimes, however, investors would hit it big, so that the promise of spectacular profits lured interest from across Europe. Mostly you lost money; sometimes, though, the returns were staggering. Science served this economy of risk in surprising ways, often serving to advertize the mines for potential investors. Moreover, the economy of risk that characterized the mining regions of the Harz and Erz mountains became inextricably linked with discourses about the general welfare. My paper will examine the linkages between science, risk, self-interest and the general welfare in the context of the hard rock mines of early modern Germany.

Relativity in Cambridge Dynamics: The Sources of A. A. Robb's Optical Geometry of Motion

Scott Walter

Abstract: The powerful influence of Alfred A. Robb's work on contemporary axiomatic geometry of spacetime, and the apparent lack of such influence on his contemporaries were noted long ago by A. Briginshaw (1979). Less familiar are the origins and evolution of Robb's *Optical Geometry of Motion* (1911), as are the reasons for its flat reception in Great Britain. Based on Robb's correspondence and new archival documents, my paper traces the origins and evolution of Robb's optical geometry, and casts Robb's work and its immediate reception in a new light. In particular, Robb's philosophical position on the geometry of phenomenal space now appears closer to Einstein's contemporary view of a physical geometry realized by ideal rigid rods and clocks, than to Poincaré's conventionalist doctrine, which ruled out any empirical determination of the geometry of phenomenal space. Robb, however, did not admit Einstein's distant simultaneity, rigid rods, or ideal clocks, an approach I trace to his Cambridge training in

Lagrangian dynamics and its application during post-graduate studies of the Zeeman effect under Woldemar Voigt's supervision in Göttingen.

Making Transnational Science

Zuoyue Wang

Abstract: This paper compares and contrasts the experiences of two groups of American-educated Chinese scientists—those who returned to China and those who stayed in the US after the establishment of the People's Republic of China in 1949. Drawing from newly available sources and oral history interviews, the paper examines both state actions and individual choices that led to the migration of scientists in and out of China in this period, as well as the effects of such migration on the making of transnational science in China and the US during the Cold War and beyond. The main argument is that the migration of scientists between China and the US helped not only to spread American influence in international science but also to internationalize/transnationalize the American scientific community.

"To Monopolize the Beauties of All the Modern Scientific Publications": Diffusing Knowledge with *Nicholson's Journal*, 1797-1820

Iain Watts

Abstract: The first years of the nineteenth century witnessed the rise of the commercial scientific periodical in Britain. These novel forms of specialist print media challenged the dominance of learned academies and their Transactions or Proceedings in publicising, circulating, and assessing new scientific knowledge. I take up the story of *Nicholson's Journal* (founded 1797), the first commercial scientific periodical of this new type in Britain, which, appearing regularly every month, constituted a flexible forum in print in which an unusually wide class of participants – from handloom weavers to Baronets – could publicise and consume original and reprinted scientific articles. I will sketch out how this project played out in practice between editors, contributing authors and correspondents, and readers, and will stress the uncertain and contested status of the scientific periodical in this period and its close relation to general periodicals or magazines – a very different picture from that pertaining after the consolidation of the modern scientific journal later in the century. Of particular importance in this regard will be the use of anonymity as a cultural form of public intellectual expression, and the practice of reprinting material from a wide variety of sources. A close examination of a dispute over reprinting rights between periodical editor William Nicholson and President of the Royal Society Sir Joseph Banks will be used to illuminate the coexistence of competing economies for the diffusion of scientific knowledge in print.

Nuclear Secrets in the Twilight Zone: The H-bomb "Gag Order" of 1950

Alex Wellerstein

Abstract: The use of secrecy restrictions to "gag" scientists with government affiliations and relevant expertise by the U.S. Atomic Energy Commission (AEC) during the debate over the hydrogen bomb in 1949-1950 has been interpreted by commentators retrospectively as evidence

of the inherent contradiction in maintaining a democratic, informed public while meeting the needs of the modern security state. These censorship actions notoriously included events like the burning of thousands of copies of a Scientific American issue with an article by Hans Bethe allegedly containing "restricted data." My paper re-examines the "gag order" on the hydrogen bomb enforced by the AEC. Internal AEC records reveal that the agency actually resisted and attempted to overturn the "gag order," which had been secretly imposed on them by President Truman. Rather than endorsing heavy-handed secrecy, the AEC in fact found the order unworkable and undesirable, and attempted to redefine its own responsibilities with regard to the control of information that lay in the "twilight zone" between political and technical speech. Their compromise position, formally articulated in the wake of the Bethe episode, involved explicitly disavowing any attempt to monitor "secrets" in the private sphere, and instead focused their efforts on policing the activities of their affiliated scientists. This shift of emphasis from the secret's ontology towards the secret-holder's identity had important consequences for the late Cold War. This episode provides a potent example of the ways in which secrecy regimes mask their own operation to contemporaries, thereby falsely appearing monolithic.

A Better Nation through Agriculture": 4-H Clubs and the Science of Rural Development

Amrys O. Williams

Abstract: In 1914, the U.S. Congress established the Extension Service, an arm of the Department of Agriculture tasked with "diffusing among the people ... useful and practical information on subjects relating to agriculture and home economics." This paper considers the place of rural youth in the Extension Service's mission to modernize the American countryside through the application of scientific knowledge produced at land-grant colleges and experiment stations. Examining the growth of 4-H club junior extension work in the 1910s and 1920s, I show how youth became central objects and agents in this program for rural development. Because of their adaptibility, directibility, and openness to new ideas, children were seen as the keys to spreading scientific ways of living and working. At the same time, 4-H boys and girls became important elements in and contributors to the land-grant system's expanding network of knowledge about agriculture. By implementing biological ideas about the proper development of children, crops, livestock, and landscapes in projects that quite literally cultivated them all at once, I argue that 4-H sought to establish a particular "rural modernity" based on science and on farming as a way of life.

Beyond Quantum Electronics: Nicolaas Bloembergen, Directed-Energy Weapons, and the Origins of Nonlinear Optics

Benjamin Wilson

Abstract: Not long after the first working laser was constructed in 1960, military agencies began enthusiastically funding R&D in laser communications and weapons applications. While historians have treated quantum electronics (including laser) research as a quintessentially military-industrial enterprise—and, in Paul Forman’s well-known interpretation, exemplary of physicists’ intellectual capture by the national security establishment—less attention has been given to the laser’s (and by extension, the military’s) role in opening new avenues of fundamental research. This paper complicates the conventional interpretation by examining the

Cold War origins of nonlinear optics—the science of the interaction between matter and coherent light—through the career of Harvard University physicist Nicolaas Bloembergen. As an advisor to the Institute for Defense Analyses in 1961, Bloembergen proposed using intense radiation to disable ballistic missiles in flight—the concept behind "directed-energy weapons" (DEW). In the context of his military advising, Bloembergen began to consider the effects of high-intensity laser light's interaction with matter; at Harvard, under military sponsorship, his research group performed calculations and experiments helping to found the new field of nonlinear optics (earning Bloembergen the Nobel Prize in Physics in 1981). And in a fascinating twist, during 1984-86 Bloembergen co-led a controversial study of DEW, by then a central platform of the Strategic Defense Initiative. Relying on their Cold War-forged expertise in laser physics and nonlinear optics, Bloembergen's study group argued that SDI's plans for laser ballistic missile defense were not only technically inadequate, but plagued by insufficient knowledge of the relevant physical processes.

Marketing Technoscientific Selves

Matthew H. Wisnioski

Abstract: This talk shows how industrial scientists in the 1960s and 1970s came to see themselves as creative entrepreneurs in a world of hybridity, fluidity, and uncertainty by tracing the networks in which such virtues were promoted. In 1962, William G. Maass, an entrepreneurial vice president at the publisher Conover-Mast, saw an unmet need in the Cold War drumbeat for scientific communication. He formed an editorial team of science journalists and an executive board of international policymakers to produce International Science and Technology (IST), a magazine given free-of-charge to 100,000 of the world's leading scientists and engineers. IST marketed the "new world" of technoscience through a combination of interviews with Nobel Prize winners, surveys of the scientific state of the art, and case studies of the creative process. In 1969—as critiques of the "military-industrial complex" mounted—the founders of IST and many of the research managers who contributed to it, formed the Innovation Group to champion opportunities for R&D in social realms. In addition to publishing the members-only magazine Innovation, they built electronic networks in which they mingled with venture capitalists and academic social scientists to promote a vision of constant self-reinvention to keep apace of accelerating change. My talk highlights how, as neither scholarly journals nor popular magazines on the order of Scientific American, magazines like IST and Innovation present an important object of inquiry for the study of scientific publics. More significantly, it reveals a major source in the shaping of cultural assumptions and epistemological claims of commercialized science.

"The Special Gift of the Most High": The Significance of Iatrochemistry in Early New England Medical Culture, as seen through the Practice of John Winthrop, Jr.

Walter W. Woodward

Abstract: Despite the fact that they had no licensed medical doctors throughout the seventeenth century, colonial New Englanders developed a system of medical care in which they had a great deal of confidence. Alchemical medicine, as delivered by practitioners such as John Winthrop, Jr., was a crucial component of this medical system. Chemical medicaments, promoted by their

proponents as innovative and divinely granted curatives for the diseases of an increasingly corrupt age, were well suited to the intensified medical providentialism of the New England Puritans. Practitioners such as Winthrop, who dispensed these advanced curatives as part of their commitment to rendering Christian service to their communities, stood at the top of a gender collaborative medical hierarchy shaped by knowledge, status, and uncontested Puritan cultural values. Focusing on the letters and medical account books of John Winthrop, Jr. – arguably colonial New England's most admired and sought after healer - this paper analyzes the structure of the informal health care system that evolved in seventeenth century New England, and the crucial role iatrochemical theory and practice played in its development and implementation.

Ferdinand von Richthofen and the Introduction of Geology in China, 1868-1911

Shellen Wu

Abstract: Ferdinand von Richthofen (1833-1905) belonged to an age better known for its Victorian travelers and adventurers and images of the British Empire at its zenith. In his overseas research and later works with the Berlin Geographical Society, Richthofen represented the less well-studied overseas aspirations of the German Empire, in particular, the number of well-educated, technically skilled German missionaries, physicians, engineers, and geographers whose works spanned the globe. In addition to Richthofen, in the nineteenth century their numbers included the likes of the Protestant missionary in Hong Kong, Karl Friedrich August Gützlaff, the explorer of British Guyana, Robert Schumburgk, and a number of German railway and mining engineers who worked in the colonial enterprises of the various European powers. When the 35 year-old Ferdinand von Richthofen arrived in China in the fall of 1868, he had accumulated through his education and life experiences the fundamental knowledge and skills of geological fieldwork and an appreciation of the economic importance of mining. His travels over the next four years provided enough materials for publication for the rest of his life. While many Republican era Chinese geologists both knew of Richthofen and used his work as a guide for the geological survey of China, his writings also marked a watershed in foreign interest in China. If for centuries Chinese exports, the famed teas, silks, and porcelain, represented its allure, from the 1870s China's mineral wealth became its chief attraction to adventurers and the expansionary ambitions of European powers.

A Study of the Interaction between Society and Science in Japan's Postwar Recovery: Food Situations and Chemical Industry

Akinori Yamabe

Abstract: Global agriculture in the 20th century underwent a "Green Revolution" of improved machinery, irrigation and chemical fertilizers. Studies of Japan's Green Revolution have focused on later postwar periods, for example, on Japan's chemical industry after 1955. But studies of the pivotal period of 1945-1950 are few and inquire little into the era's social context. This thesis examines Japan's chemical industry in 1945-1950, particularly, its relation to the severe food shortages experienced during and after WWII. It argues that food shortages necessitated Japan's intense development of chemical fertilizers, thereby spurring the rebirth of Japan's chemical industry and laying the foundation for post-1955's rapid growth and social change. The research draws upon administrative materials, numerical data, magazine pictures and illustrations and

other primary sources. First, I trace the chemical industry's transition from maker of pre-war fertilizer to wartime munitions. Next, I note the severity of wartime damage suffered by Japan's chemical factories, and the extent of Japan's postwar food shortages. I then observe the GHQ's and Japanese administration's policies to revive the chemical industry (specifically its production of ammonium sulfate) in an attempt to boost food output. From agricultural magazines published from 1945-1955, we see that farmers welcomed and embraced the use of these chemical fertilizers. I conclude from the above that post-war food shortages were fundamental to the chemical industry's rebirth and rapid growth from 1945-1955, which in turn grew into the enormous chemical industry of modern postwar Japan.

Dialects, Speech, and Information: Chao Yuen Ren's Route to Cybernetics

Chen-Pang Yeang

Abstract: A founder of modern Chinese linguistics, Chao Yuen Ren (Zhao Yuenren, 1892-1982) is famous for his extensive surveys of dialects and promotion of a national language. This paper examines a less familiar part of his later career: his thought and use of cybernetics. When Chao taught at Harvard in 1947, he read Norbert Wiener's manuscript on the topic, and immediately acknowledged its importance. In 1953, Chao attended the Macy Conference (the major symposium for cybernetics) to give a paper on meaning. In the following decades, he further developed his thought and introduced it to his research on Chinese language. Chao's cybernetic vision was closer to Claude Shannon's than Wiener's, however. He was more concerned with the statistical distinctiveness of morphemes, quantitative measure of redundancy, and varying degrees of meaning in Chinese. Although he attributed languages' information-theoretic "forms of meaning" as products of long-term negative feedback, he nonetheless stressed their stability and non-plasticity, unlike the contemporary Western cognitive scientists that highlighted feedback's open-endedness or the later Communist technocrats that championed the power of human actions in controlling feedback systems. I will explore aspects of Chao's intellectual trajectory that may give rise to this view: his lifelong preoccupation with oral languages in both field and laboratory, his commitment to structuralism, and his attempt to modernize a longstanding humanistic area of study among Chinese literati -- phonology -- with "scientific methods" that characterized the intellectuals of the May Fourth generation.

Education, Evolution and Race Progress: Implications of Organic Selection

Jacy L. Young

Abstract: In New York City, in the winter of 1896, American psychologist James Mark Baldwin, British comparative psychologist Conwy Lloyd Morgan, and American vertebrate paleontologist Henry Fairfield Osborn each, seemingly independently, proposed a new evolutionary selection theory. This theory, organic selection, provided a non-Lamarckian means by which consciousness could guide the course of biological evolution. While the theory was on the one hand a response to the recent work of August Weismann, which challenged the possibility of the inheritance of acquired characters, it was also a response to the society in which these three men found themselves. In this presentation it will be argued that the impetus for Baldwin, Lloyd Morgan, and Osborn's proposal of organic selection was their respective professional investment in education, as well as their commitment to the social import of

education. Although working in different fields, each of organic selection's originators was professionally involved in educational endeavors. These professional, education-oriented activities included both research on educational topics (e.g., learning) and efforts in public education. In the context of their newly proposed evolutionary selection theory, education had particular significance as it could effect permanent, biological change in society. For Baldwin, Lloyd Morgan, and Osborn, organic selection served as both a means of bolstering the importance of professional educational endeavors and of ensuring the possibility of race progress through educational initiatives. Finally, the development of organic selection foreshadows the later explicitly eugenic commitments of Baldwin and Osborn.

"Nation" and "Mankind": Nationalism and Cosmopolitanism in 19th Century European National Museums

Jason Young

Abstract: The spatial and political reorganization of Europe has led many to suggest 'national identity' is declining. The prominence of 'cosmopolitanism' in contemporary social science discourse reflects efforts to capture this. Concurrently, Europe has also seen new claims to recognition of basis of national self-determination. This paper demonstrates that the co-presence of nationalism and cosmopolitanism are not irreconcilable opposites but instead share intertwined roots in Enlightenment thought. This paper argues that national museums are important sites for engaging with the spatial and cultural implications of cosmopolitanism and nationalism. National museums are exemplarily cosmopolitan-nationalist institutions: cosmopolitan, as their collections represent the genius of mankind as a whole. Yet they are also nationalist in the sense that national ownership of the artifacts represents national greatness. These museums also provided a template upon which differences between cultures were articulated. Museums provided an institutional form to 'public science' that was reproduced across proto-national spaces. No self-respecting great city could do with out a public museum, and the museums of other cities provided the benchmarks against which status was measured. This competition served to reinforce 'national' differences in both intellectual and built environments. Museums are not just a window into the political and intellectual climate of the societies of which they are part, but also actively influence how their public and scholarly patrons alike perceived the world. This paper is part of a larger project exploring nationalism and cosmopolitanism through the personal correspondences of museum curators.

Dilemmas Engaged or Deferred in Twentieth-Century Scientific Ethics and Activism

Nasser Zakariya

Abstract: Here, I examine the repeated, decades-long call to a new ethics provoked by twentieth-century science, taking J.D. Bernal's essays of late 1920s as a departure point. I will compare Bernal to contemporary scientists such as Harlow Shapley, for whom scientific exploration was also put forward in popular and more recondite venues as both the root of a modern spiritual quandary and its solution. The morality these thinkers invoked often bore strong continuities with secular humanistic and political trends. But questions for this paper are whether and how their insistent focus on materiality allowed them to appeal to "humanity as a whole" as explicitly set against new global problems and common enemies such as disease. These

arguments became a justification for a political activism and resisted easy separation between visions of science and morality. By the late 1970s, E. O. Wilson gave three such arguments the name of "spiritual dilemmas," knotty correlates to scientific progress. To the first two, that moral guidance could not be found in the transcendental, and that ethics was therefore reduced to selection from innate tendencies, he proposed potential solutions: that the "evolutionary epic" be proselytized with mythopoetic force, and that a "biology of ethics" be established to clarify the material foundations of our spiritual values. The third dilemma, that knowledge and technology would soon allow humanity to alter its very essence, was left to future generations – but trusting that the new scientific myth would be adequate to a new humanity's moral and spiritual needs.

"A Difficult Figure": Ptolemy's Menelaus Theorem in the Middle Ages

Henry Zepeda

Abstract: In his Almagest, Ptolemy proves the Menelaus theorem, which treats the relationships of arcs on the surface of a sphere and which was the basis for all of Ptolemy's spherical astronomy. Most importantly, it allowed the astronomer to convert between measurements along the celestial equator and the ecliptic, the path of the sun throughout the year, and to find the rising times of different stars and planets at different latitudes, which was important not only for theoretical astronomy but also for the construction of horoscopes. Because this proof was difficult and so fundamental to astronomy and astrology, medieval scholars of the West wrote several treatises to explain it, and many commentaries and glosses on the Almagest treated this theorem at length. Medieval scholars in the West had a translation of Jabir ibn Aflah's "corrected" Almagest that replaced all the uses of the Menelaus theorem with alternative proofs because Jabir did not like the theorem, but they continued to study the more difficult Ptolemaic version. Because this theorem required an advanced understanding of proportion theory, it became an important locus for discussions of proportions that were influential in all of the mathematical sciences as well as in natural philosophy. Relying upon my examination of dozens of unexplored manuscripts, I will describe the medieval commentaries on the Menelaus theorem, the theorem's role in astronomy, its advantages and disadvantages compared to Jabir's alternative, and the influential proportion theory contained in these commentaries.

Kepler's Novel Method of Calculating the Eccentricity of the Sun

Yaakov Zik

Abstract: The method of calculating the eccentricity of the Sun's circle was based traditionally on the measurement of the time periods of the seasons as well as the length of the year. Tycho Brahe followed this tradition, but Johannes Kepler was not satisfied with Tycho's determination of this parameter. In July 1600, in a letter to Herwart von Hohenburg, Kepler explained that in order to confirm his polyhedral hypothesis he needed accurate magnitudes of eccentricities and positional data. Kepler's insistence on accurate observations was one of the reasons for his meeting with Tycho at Benatky Castle in April 1600. However, Tycho's calculations of the planetary eccentricities and especially that of the Sun's circle were not sufficiently accurate for Kepler. Moreover, he realized that, like Ptolemy and Copernicus, Tycho too accounted for the mean motion of the Sun and not for its true motion. In 1604, in his *Astronomiae pars optica*, Kepler informed the reader that by the end of 1602 he had discovered a new method for

measuring the apparent diameters of the Sun and Moon. Kepler's optical method was sufficiently accurate to show variations in the apparent diameters of the Sun throughout the year. Measurements of the apparent solar diameter at the four cardinal points (i.e., equinoxes and solstices), provided Kepler with data from which he could calculate the eccentricity of the Sun's circle. We discuss this new optical method which helped Kepler determine with greater accuracy than ever before a crucial astronomical parameter—the eccentricity of the Sun's circle.

Wild Rice—The Breadfruit of the North

Anya Zilberstein

Abstract: In 1806, William Dandridge Peck, Harvard's first Professor of Natural History visited Royal Society President Sir Joseph Banks's London garden to view his North American plants and was particularly intrigued by the overgrowth of Canadian wild rice (*Zizania aquatica).* Peck brought home some of Banks's domesticated Zizania seeds preserved in wet moss and stuffed in a tin canister, which he distributed to American botanists and advised them to toss the grains into local ponds. Traveling naturalists including Mark Catesby, John and William Bartram, Pehr Kalm, and Luigi Castiglioni had studied the indigenous culture of this northern cultivar and the possibilities for acclimatizing it to warmer environments. Peck and Banks both experimented with the idea of Zizania as a commercial crop, hoping to popularize it as a cheap food for workers, the poor, and slaves (for example, Banks proposed a wild rice plantation in Australia). My paper will examine the little known global career of this food plant during the long eighteenth century. Situating it in the history of colonial botany and the politics of food science, I will show that it was a cold climate counterpart to Banks's infamous breadfruit scheme.

The Tale of Bathybius: Of Sea, Ships, and Urschleim

Emma Zuroski

Abstract: In 1875 the specimen known as Bathybius Haeckelii, having just been discovered seven years previously, experienced an inauspicious end when Thomas Huxley published a short piece in the journal Science admitting that his discovery of Bathybius was a "mistake," and that the substance he believed to be an organic protoplasm was in fact merely an inorganic precipitate of lime. Huxley attributed this correction to the work done by the naturalists onboard the HMS Challenger, lead by head naturalist C Wyville Thomson, who had written to Huxley while the Expedition was still at sea. This paper aims to analyze the central role of the HMS Challenger within the Bathybius controversy. How was it that Thomas Huxley, the man in the metropole – with all of his credentials and authority – so readily disposed of the notion of a substance which, just years earlier he had believed to be the answer to the great mystery of the origin of life? Furthermore, how was it that C Wyville Thomson, onboard a ship and thousands of miles away from London in the middle of the Pacific Ocean could so quickly disprove Huxley's new scientific discovery? The answer, I suggest, lies in the Challenger's novel characteristic as a "floating laboratory," a moving scientific space which made the site of collection and the site of analysis one and the same. By examining the HMS Challenger as a floating lab we can see the Bathybius example as reformulating traditional metropole/periphery narratives of knowledge production.