**SARA J. SCHECHNER**

David P. Wheatland Curator of the Collection of Historical Scientific Instruments
Lecturer on the History of Science
Harvard University, Department of the History of Science
Science Center 251c, 1 Oxford Street, Cambridge, MA 02138
(617) 496-9542 | schechn@fas.harvard.edu
http://scholar.harvard.edu/saraschechner

---

**CONTENT EXPERTISE**

| | |
|---|---|
| Material Culture | History of Astronomy |
| Science and Religion | American Science |
| Early Scientific Instruments | Popular Culture and Science |

**EDUCATION**

PhD (History of Science). Harvard University, Cambridge, MA, 1988.
AM (History of Science). Harvard University, Cambridge, MA, 1982.
MPhil (History and Philosophy of Science). Emmanuel College, Cambridge University, Cambridge, England, 1981.
AB *summa cum laude* (History and Science, Physics). Harvard-Radcliffe, Harvard University, Cambridge, MA, 1979.

**AWARDS AND HONORS**

LeRoy E. Doggett Prize for Historical Astronomy, American Astronomical Society, 2018.
Great Exhibitions Prize, British Society for the History of Science, for *Body of Knowledge: A History of Anatomy (in 3 Parts)*, 2014.
Dean's Impact Award, Faculty of Arts and Sciences, Harvard University, 2014.
The Paul and Irene Hollister Lecturer on Glass, Bard Graduate Center, 2010.
First Place, Telescopes-Mechanical/Special, Stellafane Convention, for a historical quilt, "The Great 26-Inch Telescope at Foggy Bottom", 2009.
Joseph H. Hazen Education Prize, History of Science Society, 2008.
First Place, International Design Awards 2007, for *Time, Life, & Matter*, 2007.
Helen Sawyer Hogg Public Lecturer, Royal Astronomical Society of Canada, 2004.
Herbert C. Pollock Award for Research in the History of Astronomy and Astrophysics,
The Dudley Observatory, Schenectady, New York, for "Models and the Order of the World," 1993-1994.
Herbert C. Pollock Award for Research in the History of Astronomy and Astrophysics, The Dudley Observatory, Schenectady, New York, or a study of comets, popular culture, and the rise of modern cosmology, 1991-1992.
New York Academy of Sciences, from 1982.
Sigma Xi, The Scientific Research Society, from 1979.
Sigma Xi Prize, Harvard, 1979.
Phi Beta Kappa, Harvard, 1979.

**ADVISORY BOARDS**

*Journal for the History of Astronomy*—Board of Advisory Editors—from 2015 Scientific Instrument Commission, International Union of History and Philosophy of Science and Technology—*Scientific Instruments and Collections* series Editorial Advisory Board--from 2015
*eRittenhouse*—Editorial Advisory Board—from 2011
American Institute of Physics — History Task Force on Professional Standards and Operations—from 2011
Public Health Museum in Massachusetts—Collections Committee—from 2010
Center for History of Science, Royal Swedish Academy of Sciences—International Advisory Board—2008-2013

American Astronomical Society—Working Group on the Preservation of Astronomical Heritage—from 2007
Chemical Heritage Foundation—Collections Advisory Committee—2006-2008
Warren Anatomical Museum, Harvard Medical School—2001-2010

**MAJOR COMMITTEE ASSIGNMENTS**

Harvard-Smithsonian Center for Astrophysics: Great Refractor Restoration Committee, from 2016
Harvard-Smithsonian Center for Astrophysics: Sundial Design Committee, from 2016
Harvard Museums of Science and Culture: Solstice Festival Planning Committee, 2013
Harvard Museums of Science and Culture: Education Committee, 2012-2014
Harvard Museums of Science and Culture: Exhibition Committee, 2012-2014
Harvard College Observatory: History and Preservation Committee for the Digitization of the Harvard Astronomical Plate Collection (DASCH), 2013
Harvard-Smithsonian Center for Astrophysics: Committee for archiving John Huchra's research papers, 2013
Harvard-Smithsonian Center for Astrophysics: Oak Ridge Observatory Historical Committee, from 2005
Department of the History of Science: Steering Committee for the Collection of Historical Scientific Instruments, 2003-2004
Harvard University Archives: "What to Collect in Harvard Faculty Papers," 2003
Physics Department: Committee to preserve apparatus in the Jefferson Tower, 2003
Harvard University Provost's Office: Committee on Museum Digital Efforts, 2002-2004
Harvard Faculty of Arts and Sciences, Dean's Office and Rowland Institute for Science: Committee on acquisition of historical apparatus of Edwin Land and Rowland Institute, 2002
Harvard Faculty of Arts and Sciences, Dean's Office, with Harvard Planning and Real Estate, and Harvard University Archives: Committee to advise on the decommissioning, documentation, and preservation of the Harvard Cyclotron Laboratory, 2001-2002
Department of the History of Science: Exhibition Working Group, 2001-2006
Department of the History of Science: Building Committee, 2000-2005

**PROFESSIONAL SOCIETIES AND RECENT SERVICE**

AAM—American Alliance of Museums
  Curators' Committee
AAMG—Association of Academic Museums and Galleries
AAS—American Astronomical Society
  Working Group on the Preservation of Astronomical Heritage – from 2007
  Historical Astronomy Division – Past Chair, 2009-2011; Chair, 2007-2009; Vice Chair, 2005-2007; Executive Committee, 1993-1995, 1999-2001, 2005-2011; Audit Committee, 1997, 2016; Prize Committee, 2009-2011 (Chair); Nominating Committee, 1990, 2010 (Chair).
  Centennial Committee–Chairman of Exhibit Subcommittee, 1995-1999.
ATS—Antique Telescope Society
BSS—British Sundial Society
Forum for the History of Science in America
  Executive Committee, 2004-2007
HSS — History of Science Society
  Hazen Education Prize Committee, 2011-2013 (Chair, 2012-2013)
IAU — International Astronomical Union
  Division C Education, Outreach, and Heritage
  Division C Commission 41 (now C3) History of Astronomy
  Division C Commission 41 Working Group: Astronomy and World Heritage

Division C Commission 41 Working Group: Historical Instruments – Chair, 2009-2012
Division C Commission 41 Working Group: Transits of Venus
ICOM – International Council of Museums
CIMUSET – International Committee for Museums and Collections of Science and Technology
UMAC – International Committee for University Museums and Collections
Inter-Union Commission for the History of Astronomy
ISAAC—International Society for Archaeoastronomy and Astronomy in Culture
NASS — North American Sundial Society
Secretary, 1996-2001; Chair, Bylaws Revision Committee, 1995-1997; Local Arrangements/Program Committee, 1997, 2013.
SIC—Scientific Instrument Commission of the International Union of History and Philosophy of Science and Technology
*Scientific Instruments and Collections* series editor, from 2015; Secretary, 2003-2013; Scientific, program, and local organizing committees, 2006-2013; Transit of Venus Committee, 2000-2004.
SICU—Scientific Instrument Collections in the University
Steering Committee, 2002-2007
SIS—Scientific Instrument Society

**FELLOWSHIPS AND GRANTS**

American Astronomical Society Travel Fellowship to IAU General Assembly in Beijing, 2012.
American Institute of Physics, Center for History of Physics, Visiting Scholar, 1997-2000.
National Museum of American History Research Fellowship, 1997-2000.
Smithsonian Institution Libraries / Dibner Library Resident Scholar (at work on "Models and the Order of the World"), 1996-1997.
University of Maryland at College Park, Committee on the History and Philosophy of Science, Research Associate, 1993-2000.
History of Science Society Travel Grant, 1994.
Newberry Library / National Endowment for the Humanities Fellowship (to write book on the connection of modern cosmological thought to traditional beliefs about comets), 1990-1991.
National Endowment for the Humanities Planning Grant, Program of Museums and Historical Organizations (Principal Investigator / Project Director for an interpretive catalogue of scientific instruments at the Adler Planetarium), 1984-1989.
National Endowment for the Humanities Planning Grant, Program of Museums and Historical Organizations (Principal Investigator for redesign of the permanent exhibition of scientific instruments at the Adler Planetarium), 1986.
National Science Foundation Graduate Fellowship, 1980-1983.

**CURATORSHIPS**

David P. Wheatland Curator of the Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, from 2000.

Chief curator of a collection of 25,000 early scientific instruments and related books and photographs.
Work includes research and documentation of collections, museum-based teaching, exhibitions, public programs, collection management, conservation, and fund raising. (See attachments for details.)
Early responsibilities included the design and construction of a new facility and relocation of the collections into it; museum security; and the design of and migration to a new collections database.

Principal. Gnomon Research / Curators on Call, Silver Spring, MD, 1996-2000.

Customized curatorial and research services were provided to museums, institutions, and private collectors, including:

Adler Planetarium & Astronomy Museum – American Astronomical Society – American Physical Society – Associated Press – BBC – Cooper-Hewitt National Design Museum – Dibner Institute for the History of Science and Technology – *House & Garden* – National Institute of Standards and Technology – National Public Radio – New York Academy of Sciences – *Physics Today* – *Science & Vie* – Wisconsin Public Radio.

Organized and led teacher and student workshops, scouting programs, science expeditions using hands-on scientific instruments, *Shoebox Science* kits, and sundial design. (See attachments for details.)

Curator of Centennial Exhibits. American Physical Society, College Park, MD, 1997-2000.

Researched and curated three major exhibitions featured at the Centennial Meeting in Atlanta in March 1999. (See attachments for details.)

Centennial Curator. American Astronomical Society, Washington, DC, from 1995-2000.

Researched and curated a traveling exhibit.

Contract Curator and Exhibit Historian. National Museum of American History, Smithsonian Institution, Washington, DC, 1995.

Researched themes for the new, permanent exhibit, *On Time*.

Contract Curator. History of Astronomy Department, Adler Planetarium & Astronomy Museum, Chicago, IL, from 1990-2001.

As an outside consultant, catalogued recent acquisitions, answered questions posed by scholars and conservators, and prepared catalogues on astrolabes and time-finding instruments.

Chief Curator (1987-1990); Assistant Curator (1983-1987). History of Astronomy Collection, Adler Planetarium, Chicago, IL

As first professional curator hired, I managed and interpreted an internationally renowned collection of scientific instruments, rare books, and manuscripts. Launched a program of object-based teaching and research in classes and temporary exhibits.

Consultant in Collections Management. Harvard University Library, Cambridge, MA, 1985-1987.

Curatorial Assistant. Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 1981-1983, 1977-1979.

**TEACHING APPOINTMENTS**

Lecturer on the History of Science. Department of History of Science, Harvard University, Cambridge, MA, from 2016.

Design and teach customized, object-based seminars for 20-25 distinct college and graduate courses visiting the Collection of Historical Scientific

Instruments each year from many divisions of Harvard University and those of New England regional colleges.
Lead 15-20 tours and programs per year for special interest groups.

Lecturer. Program in General Education, Harvard College, Cambridge, MA, from 2015.

United States in the World 30: “Tangible Things: Harvard Collections in World History,” co-taught with Laurel Thatcher Ulrich, 2015, 2017.

Instructor and Course Developer. HarvardX / edX, Cambridge, MA, from 2014

United States in the World 30x: “Tangible Things: Discovering History through Artworks, Artifacts, Scientific Specimens, and the Stuff around You.” MOOC offered in 2014, 2015. With concurrent seminar for staff of Harvard Museums of Science and Culture, 2015.

“PredictionX.” MOOC under development by Alyssa Goodman and a team of faculty experts, from 2014. Topics: ancient omens, comets, history of astronomy, navigation, scientific instruments and clocks, Copernicus to Newton.

Thesis Committee. Doctorate in Education, Harvard University Graduate School of Education, Cambridge, MA, 2011-2014.

Supervised a dissertation on museum programming for seniors.

Faculty. Master of Liberal Arts in Museum Studies, Harvard University Extension School, Cambridge, MA, 2004-2013.

“Introduction to Museum Studies,” required course for masters candidates. Taught 1-3 times per year, with distance education options, 2004-2013.

Thesis Committee Chair. Master of Arts in Historic Preservation, Welch Center for Graduate and Professional Studies, Goucher College, Towson, MD, 2011-2013.

Supervised a thesis on architecture of historic college observatories in New England.

Adjunct Professor. Department of History and Committee on the History and Philosophy of Science, University of Maryland, College Park, MD, 1995-2000.

"Science and Technology in Western Civilization," 1995 (core-curriculum survey for 160 students, with lectures, discussion sections, and field trips; object- and museum-based teaching; and a gnomon project that gave students the chance to use ancient scientific instruments in order to make observations and through these to learn more about empirical science and its history).

Visiting Professor. Department of Science, Technology, and Society, Sarah Lawrence College, Bronxville, NY, 1991-1992.

"Popular Culture, Magic, and Science" (seminar), 1992.
"New Worlds" (seminar on the Scientific Revolution), 1991.

Faculty. The Adler Planetarium, Chicago, IL, 1983-1990.

"Bearded Stars: Theories of Comets from Antiquity to 1850," 1985.

Teaching Fellow. History of Science Department, Harvard University, Cambridge, MA, 1982-1983.

Dunster House Tutor / Fellow in the History and Philosophy of Science. Harvard University, Cambridge, MA, 1981-1983.

Physics Laboratory Instructor. Physics Department, Harvard University, Cambridge, MA, 1977-1978.

Tutor in Mathematics and Physics. Bureau of Study Counsel, Harvard University, Cambridge, MA, 1976-1977.

**EDITORSHIPS**

Editor. *Scientific Instruments and Collections*, Brill series, from 2015.

Advisory Editor. *Journal for the History of Astronomy*, from 2015.

Advisory Editor. *eRittenhouse*, from 2011.

Editor. *Biographical Encyclopedia of Astronomy*, 2001-2002.

Editor. Historic Scientific Instruments of the Adler Planetarium, 1984-1998.

Editor / Historical Consultant. *Earth, Sea, and Sky: The Work of Edmond Halley* by Linda Girard, a children's biography, 1984-1985.

Editor / Historical Consultant. *Amedeo Avogadro* by Mario Morselli, 1981-1984.

Historical Editor / Archives Technician. Thomas A. Edison Papers, Edison National Historic Site, West Orange, NJ, Summer 1979.

Editor-in-Chief and Publisher. *Synthesis: The University Journal in the History and Philosophy of Science*, Cambridge, MA, 1977-1979.

**SCIENTIFIC RESEARCH**

Research Assistant. Fluid dynamics laboratory of Frederick Abernathy, Department of Applied Physics, Harvard University, Cambridge, MA, 1978-1979.

**ATTACHMENTS**

Exhibitions
Publications
Books, Essays and Articles, Book Reviews, and Online Resources
Invited Lectures
Hands-On Workshops
Interactive Learning Materials
Sundial Designs, Learning Sculptures, and Activity Kits

Revised 22 February 2018

**SARA J. SCHECHNER**

---

**EXHIBITIONS**

*Starstruck! Astronomers and Popular Culture*¸ Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2017-2018.

Telescopes and a last will and testament. Clocks, a sketch of a comet, and a life mask. Astronomical photographs, a fly spanker, log books of data, and a tea set. Observers of Sputnik. Sheet music, trade cards, and a *Wonder Woman* comic strip. As disparate as they may seem, these objects are all tangible things of American astronomy in the last 200 years.

They are assembled together in this exhibition to reveal how three significant Harvard astronomers—William Cranch Bond, Annie Jump Cannon, and Fred Whipple—were not secluded on Observatory Hill nor were they removed from the social rituals, entertainments, business, and politics of their times. On the flip side, ephemeral publications such as greeting cards, advertisements, and vinyl records illustrate how contemporary popular culture drew inspiration from astronomers' work and the celestial bodies they studied. It also reflected different cultural expectations for women and men in and out of the observatory

This exhibition was curated by nine students working with me as their final project in a large undergraduate course at Harvard, USW30: Tangible Things: Harvard Collections in World History, taught in 2017 by Laurel Thatcher Ulrich and Sara Schechner.

*Scale: A Matter of Perspective*, Harvard Museums of Science and Culture, Collection of Historical Scientific Instruments, Cambridge, MA, 2017.

This exhibition explored the concept of scale from multiple perspectives, including investigation of the cosmos with telescopes and microscopes, models that scale things up (e.g., molecular models, glass flowers, embryological models) and those that scale things down (e.g., celestial and terrestrial globes, or ethnographic dioramas of village life), scale in literature, and social scale.

The central focus object was the optics of the 125-year-old Bruce photographic telescope, recently discovered and restored. Accompanying the Bruce lenses were astronomical photographs on glass plates taken in Peru that were annotated by Henrietta Leavitt, a "computer" at Harvard College Observatory, and her logbooks. Leavitt's discovery of the period-luminosity relationship of Cepheid variable stars fundamentally altered our view of the scale of the universe. [Curated with HMSC Exhibition Department.]

*In the Lab with Stevens and Skinner*, Department of Psychology, William James Hall, Harvard University, Cambridge, MA, from 2017.

The basement of Memorial Hall was home to the Psychological Laboratories of two pioneers: S. S. Stevens and B. F. Skinner. At one end was the Psycho-Acoustic Laboratory, established in 1940 by Stevens at the request of the US Army Air Corps. His mission was to improve communication in noisy combat aircraft flying at high altitudes. After the war, Stevens studied scales of measurement, and developed a psychophysical power law, which related the strength of a physical signal to its perceived intensity. At the other end of the basement, Skinner set up his Pigeon Lab in 1948. He too had done war work, training pigeons to guide missiles to enemy targets. At Harvard he studied how

behavior was shaped by the environment and the consequences of actions in a process he named “operant conditioning.” Operant conditioning applied to the actions of all organisms. “Men and women act upon the world, and change it, and are changed in turn by the consequences of their action,” Skinner remarked.

The exhibit sets up apparatus used by Skinner and Stevens in order to give spectators the sense that they are in the lab with these two scientists.

*Radio Contact: Tuning In to Politics, Technology, & Culture*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2016.

Remember the times when the whole family gathered round the living room radio to listen to Roosevelt's fireside chats or detective dramas like *The Shadow*? When boys and sometimes girls tinkered with ham radio in garages in order to talk to people across the country? When commercial, underground, and political networks broadcast to a fragmented society, giving voice to diverse ideas and music, which anyone could sample? Showcasing radio equipment from the Collection of Historical Scientific Instruments, *Radio Contact* examined the evolving technology and cultures of listening, tinkering, and broadcasting. [Co-curated with two graduate students.]

*A Case for Curiosity: Old Objects, New Contexts, Unexpected Stories*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2015-2016.

The microscope of a literary legend, an illustration of a cannibalistic fish in the middle of his supper, and the nose cone of a missile given as a Valentine's Day gift. On display, these objects and many seemingly disparate items come together to illustrate the interwoven and multidimensional nature of history. Although all belong to Harvard's Collection of Historical Scientific Instruments, they are not solely defined by their scientific functions. This exhibition shows how they connect broadly to major historical movements in the United States and cultural issues such as race, gender, politics, health, communication, memory and art.

This exhibition was curated by nine students working with me as their final project in a large undergraduate course at Harvard, USW30: Tangible Things: Harvard Collections in World History, taught in 2015 by Laurel Thatcher Ulrich and Sara Schechner.

*Finding Our Way: An Exploration of Human Navigation*, Harvard Museums of Science and Culture, Cambridge, MA, 2015.

Contributed expertise on the history of navigation and its instruments [Staff curator assisting faculty guest curator John Huth and the HMSC team.]

*Body of Knowledge: A History of Anatomy (in 3 parts)*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2014.

This award-winning exhibition explored the act of anatomizing not as a process of mapping a finite arrangement of bodily structures, but as a complex social and cultural activity. *Body of Knowledge* attempted to capture the complexity of the many people, places, and meanings involved in human dissection. The exhibition was divided into three sections:

- *Preparation*. How have bodies been sourced and prepared for dissection? How have would-be anatomists articulated their goals and

obtained support from religious and political authorities?
- *Dissection.* Where have dissections been performed and by whom? What tools have been used? Who were the audiences?
- *Afterlife*. Dissection did not end when the cutting stopped. The material and cultural afterlife of dissection reflects a constant struggle between the forces of transience—a decomposing cadaver or fallible memories—and immortality—of the soul, of the remains, of scientific knowledge, and even of the reputation of the dissector.

Body of Knowledge was a collaboration of the Collection of Historical Scientific Instruments, Center for the History of Medicine in the Countway Library of Medicine, and Harvard Medical School's Program in Medical Education. [Co-curated with several faculty members, curators, and grad students.]

Body of Knowledge received the 2014 Great Exhibitions award from the British Society for the History of Science.

*The Mark I Computer at Harvard*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, from 2014.

Originally called the Automatic Sequence Controlled Calculator, Mark I was designed in 1937 by a Harvard graduate student, Howard H. Aiken to solve advanced mathematical physics problems encountered in his research. Aiken's ambitious proposal envisioned the use of modified, commercially-available technologies coordinated by a central control system. Using company components, IBM engineers in Endicott, NY developed the machine's working systems and directed its construction over five years. When Mark I was finally delivered to Harvard in 1944, it was operated by the U.S. Navy Bureau of Ships for military purposes, solving mathematical problems that until then required large teams of human "computers."

In the spring of 2014, seventy years after Mark I's arrival at Harvard, a renovation of the permanent exhibit reinterpreted the machine's significance from a 21st century perspective. Special attention was paid to the crew, which included Grace Hopper, the futuristic look of the Mark I, and how the physical characteristics of the Mark I and its encoded paper tapes gave rise to common programming terms such as the loop, the patch, the library, and the bug. [Co-curated with grad students Juan-Andres Leon and Laura Neuhaus.]

*Time & Time Again: How Science and Culture Shape the Past, Present, and Future*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2013.

Time: We find it, keep it, measure it, obey it, rely on it, waste it, save it, chop it and try to stop it. We organize our lives around it, and yet, do we really know what time is? Drawing upon collections in Harvard's scientific, historical, archaeological, anthropological, and natural history museums and libraries, this exhibition explored the answers given to that question in various ages by different world cultures and disciplines. Themes included time finding from nature and time keeping by human artifice. Visitors explored cultural beliefs about the creation and end of time, the flow of time, and personal time as marked by rites of passage. They took time out and examined the power of keeping time together in music, dance, work, and faith. They discovered time's representation in history and objects of personal memory, its personification in art, and its expression in biological change and the geological transformations of our planet.

A free smartphone app led visitors beyond the primary exhibition in the Science Center to other sites on the Harvard Campus where they could explore the concepts of time. Among these were 40 thought-provoking objects throughout the galleries of all four of the Harvard Museums of Science and Culture.

The exhibition and its eCatalog was a fundamental resource for "Tangible Things: Harvard Collections in World History," a General Education course taught in the Fall 2013, and a HarvardX / edX MOOC version of the course offered in 2014 and 2015.

*Go Ask A.L.I.C.E.: Turing Tests, Parlor Games, & Chatterbots*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2012.

Can machines think? This exhibit explored the strange afterlife of the Turing Test as it has circulated in popular, scientific, and commercial cultures. It reexamined Turing's own interactions with humans and machines, later dreams of thinking machines, as well as an effort to translate Turing's parlor game into a real test of artificial intelligence. [Staff curator assisting faculty guest curator Sophia Roosth and two grad students.]

*X-Rays of the Soul: Rorschach and the Projective Test*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2012.

In 1911, Swiss psychiatrist Hermann Rorschach began experimenting with inkblots to probe previously inaccessible layers of the unconscious self. Rorschach's success led to the Thematic Apperception Test (TAT), created at Harvard in 1935 by lay psychoanalyst and artist Christiana Morgan along with psychologist Henry Murray. Instead of abstract blots yielding short responses, this new test centered on representational images that stimulated patients to tell stories. From the genesis of the tests in passionate personal relationships to the recent Wikipedia furor over posting the Rorschach images, this exhibition sought to capture the neglected history of these projective tests and their grip in science, hospitals, courts, popular culture, and art. [Staff curator assisting faculty guest curators Marla Eby, Peter Galison, and Rebecca Lemov.]

*Cold War in the Classroom*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2011.

In 1956, the head of the Atomic Energy Commission, Lewis Strauss, declared that the United States was waging a "Cold War of the Classroom" against the Soviet Union. New scientific curricula and toys trained children to think about the world in a way deemed essential to American supremacy. This exhibition transformed the gallery into a mid-century, science classroom in order immerse visitors in Cold War lessons. [Staff curator assisting grad-student guest curators.]

*Tangible Things*, Collection of Historical Scientific Instruments and satellite installations around Harvard University, Cambridge, MA, 2011.

What do a Galapagos tortoise, a teapot, and a hundred-year-old tortilla have in common? They were part of an exhibition that brought together over 200 objects from the back rooms of Harvard¹s museums and libraries, raising questions about distinctions between nature and artifice, art and artifact, specimen and tool, and the historical and anthropological.

Beginning in the Collection of Historical Scientific Instruments, the exhibition introduced visitors to established ways of organizing things and challenged them to classify an assortment of objects according to these conventions. Where in the university do items like John Singer Sargent's palette or the beads and dress of a Camp Fire Girl belong? Why? Armed with these questions, visitors were invited to discover the many guest objects carefully inserted into exhibitions of Harvard's public museums.

The exhibition was a fundamental resource for "Tangible Things: Harvard Collections in World History," a General Education course taught in the Spring 2011. [Co-curated with Laurel Ulrich, Ivan Gaskell, and Sarah Carter.]

*Sensations of Tone: Acoustic Instruments and the Sight of Sound*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2010.

This exhibition featured 19th century acoustic instruments that made sound visible through ribbons of light, vibrating flames, and patterns of sand. It was part of a larger program, "Sensations of Tone: Wave Physics and the Creative Arts," in which spectral music was performed by soprano Jane Sheldon and the Firebird Ensemble in the exhibition gallery.

*From Lab & Field*, Offices of the Dean (Chief Academic Officer), the Administrative Dean of Science, and the Assistant Dean for Faculty Affairs, Faculty of Arts and Sciences, Harvard University, Cambridge, MA, from 2010

Historical instruments used by Harvard scientists are part of changing exhibits in the meeting spaces and offices of several senior deans.

*Fugitive Sparrows: An Emily Dickinson Installation*, Woodberry Poetry Room, Lamont Library, Harvard University, Cambridge, MA, 2010.

In celebration of National Poetry Month, this installation showcased artwork by Zachary Sifuentes based on Emily Dickinson's poetry and creative process, using optical instruments, letterpress printing forms, poems placed in Harvard Yard, and abstract art made up of the text of Dickinson's complete works. The installation challenged viewers to confront the act of reading by having them read excerpts from Dickinson's poems by looking through telescopes and lenses, into a mirror, or following a line of sight in an 1844 dictionary. [Co-curated with Zachary Sifuentes.]

*The Rediscovery of the Mind: Harvard and the Cognitive Revolution*, William James Hall, Harvard University, Cambridge, MA, from 2007.

This new, permanent exhibit examines the Cognitive Revolution from a Harvard perspective. By the middle of the 20th century, psychology was no longer the "science of mental life," as William James had called it, but the "science of behavior." But in the postwar years, new ideas from linguistics, computation, and information theory overturned this world view and led to a rediscovery of the mind. The turning point was 1956, when three epochal publications by researchers with Harvard ties forever changed the field: George Miller's *The Magical Number Seven Plus or Minus Two*, Jerome Bruner's *A Study of Thinking*, and Noam Chomsky's *Three Models for the Description of Language*, based on work he did as a Junior Fellow before his move to MIT the year before. Soon Miller and Bruner would set up the Harvard Center for Cognitive Studies, a hothouse for new ideas whose alumni went on to found cognitive science

programs all over the world. [Co-curated with Steven Pinker and Jamie Cohen-Cole.]

The opening of the exhibit was accompanied by a major public symposium, "The Cognitive Revolution at Fifty, Plus or Minus One: A Conversation with Jerome Bruner, Susan Carey, Noam Chomsky, and George Miller, moderated by Steven Pinker."

*The World of 1607,* Jamestown Settlement, VA, 2007-2008.

This exhibition–divided into four cycles–commemorated the 400th anniversary of the founding of Jamestown, Virginia, by placing America's first permanent English colony in a global context, portraying a larger world of discovery, strife, expansion, innovation, artistic expression, and cultural exchange. The conceptual framework of the exhibition and accompanying catalog were developed in collaboration with a group of 28 internationally recognized scholars, each of whom explores an aspect of the intellectual and cultural life of peoples around the globe at the beginning of the modern era. I curated Cycle IV: "New Worlds, New Scientific Instruments: Cosmology, Mathematics and Power at the Time of Jamestown." [Contributing curator.]

*Benjamin Franklin: A How-To Guide*, Houghton Library and the Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2006-2007.

Commemorating the 300th anniversary of the birth of Benjamin Franklin, this joint exhibition appeared in two Harvard venues. At Houghton Library, the exhibition examined the *Circulation of Knowledge*, focusing on how information was made public. At the Collection of Historical Scientific Instruments, the focus was on *Science and Sociability*, exploring how science was part of a social context that prized human interaction and collaboration. The exhibition featured rare books, broadsides, manuscripts, scientific instruments, natural history specimens, art, and music. Topics included *How to...be Charming,...see Clearly, ...do an Experiment,... learn Things, ...get the Word Out, ...do Good,...be a Political Animal,...see the World,...win Friends and influence People,...be Benjamin Franklin*. [Co-curated with Joyce Chaplin and Thomas Horrocks.]

*Time, Life, & Matter: Science in Cambridge*, Putnam Gallery, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, from 2005.

This award-winning permanent exhibition traces the development of scientific activity at Harvard, and explores how science was promoted or affected by religion, politics, philosophy, art, and commerce in the last 400 years. Five themes serve as the framework for exploring interconnected ideas across disciplinary and chronological lines: Colonial Science, Natural Philosophy, Astronomer's Time, Mind and Body, and Physical Matters. Featured objects include instruments connected to Galileo, Benjamin Franklin, William James, and Charles Lindbergh.

First Place, interior/institutional design category, International Design Awards 2007.

*Bringing Nature Inside: 17th Century Natural History, Classification, and Vision,* Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2004-2005.

Working from the celebrated frontispiece and catalogue of *Worm's Museum, or the History of Very Rare Things, Natural and Artificial, Domestic and Exotic, Which Are Stored in the Author's House in Copenhagen* (1655), Rosamond Purcell recreated the private museum of a Danish professor of medicine, Ole Worm (1588-1654), by using natural history specimens and ethnographic objects borrowed from collections at Harvard and elsewhere in the United States. In reconstructing Worm's world, Purcell, an installation artist, and I explored not only the place of Worm's cabinet among other early museums and the ways he organized his collection, but also the issues that arose in representing nature through the sense of sight.

*Transits of Venus*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2004.

Part of the *Festival of the Transit of Venus* organized at CHSI for the transit on June 8, 2004, this exhibit examined the impact of pre-Revolutionary politics on Harvard's expeditions to observe the Transit of Venus in 1761 and 1769. On display were instruments selected by Benjamin Franklin for John Winthrop's observations.

*History from Scientific Instruments*, Collection of Historical Scientific Instruments, Harvard University, Cambridge, MA, 2003-2004.

An examination of historical themes that can be explored by close inspection of material culture, including politics, religious faith, consumer culture, provincialism, field work, computing, modeling, and experiment.

*Physics Works! Exploring Nature, Saving Lives, Driving Technology*, traveling 1999-2002.

Inspired by the work of physicists who have received Nobel Prizes, but aimed at an adolescent audience, this playful and upbeat exhibit showed how much physics exerts a positive force in people's lives. Filled with unique hands-on scientific activities, this exhibit was distinguished from Exploratorium-style exhibits in that its interactives not only taught physics but also placed it into social and methodological contexts.

*Physics Works!* was divided into four sections: (a) Physics Explores the Wonders of Nature; (b) Physics Saves Lives; (c) Physics Drives Technology; and (d) Physics Looks to the Future. Each section featured a large representational, hands-on component that telegraphed themes quickly to visitors. Featured components, listed by section, included: (a) a quantum corral in which visitors could climb onto atoms and explore wave-particle duality; a particle pinball machine that illustrated how scientists learn about objects that cannot be directly seen by bombarding them with particle beams; and a large plasma globe; (b) a wireform human figure loaded up with replacement body parts that used physics; and a thermoscope with an infrared camera so visitors could medically image their own bodies; (c) a giant wristwatch (with active liquid crystal face) serving as a frame to hold a rollerblade skate, solar panel, GPS, computer chip, fiber optics magnifier, and more, to illustrate the role of physics in designing everyday items; and a laser speckle experiment in which visitors could test their eyesight while learning about coherent light; and (d) a chaotic pendulum.

The exhibition opened at the Georgia World Congress Center in Atlanta during the American Physical Society's Centennial Meeting in March 1999 and then

traveled to the Don Harrington Discovery Center in Amarillo, TX, before residing at the Fernbank Museum in Atlanta.

*To Advance & Diffuse the Knowledge of Physics: 100 Years of the American Physical Society*, traveling and online, 1999-2000.

This major traveling exhibit showcased archival documents, photos, and artifacts as it told the story of the history of 20th century physics, the American Physical Society, and the dynamic relationship of APS and its journals to American culture and politics.

The display served as the gateway to the APS Centennial Meeting and Physics Festival in Atlanta in March 1999 at the Georgia World Congress Center. Since then the exhibit has been shown to members of the U.S. Congress on Capitol Hill, at the American Center for Physics, and at the National Institute of Standards and Technology. In March 2000, the exhibition was featured at the New York symposium, "Creating Copenhagen," which examined the relationship of Bohr and Heisenberg, physics, philosophy, and politics, on the occasion of the opening of a Broadway play that dealt with those topics. After the symposium, the exhibition was on display at the official opening of the new CUNY Graduate Center. Excerpts from the exhibition have been published in twelve issues of *APS News* and *APS News Online*.

*Nobel Discoveries*, Georgia World Congress Center, Atlanta, GA, 1999

A temporary exhibition featuring the work of over 175 physicists who have received Nobel Prizes. The exhibition was prepared with the support of the Laureates, the Nobel Foundation, the Swedish Academy of Sciences, and the American Physical Society. Fifty Laureates attended the opening.

*American Astronomical Society's First Hundred Years*, traveling 1999--2001

An exhibit that commemorates the American Astronomical Society's centennial by describing the society's formation and growth; debates over the place of physics within astronomy; roles for women; ties between professional and amateur astronomers; the AAS in the context of American politics; its outreach programs; and the history of AAS divisions. Harking back to an AAS tradition of meeting registers (samples from 1902-1970 shown in the exhibit), visitors were invited to join Simon Newcomb, George Ellery Hale, and other luminaries of astronomy by "signing into history."

The exhibit opened at the AAS Centennial Meeting in Chicago in May 1999 and then traveled to the Adler Planetarium & Astronomy Museum (Chicago), the History of Astronomy Workshop at Notre Dame, the University of Wisconsin Space Place (Madison, WI), the AAS meeting site in Atlanta in January 2000, the American Center for Physics (College Park, MD), the New York Academy of Sciences (New York, NY), the US Naval Observatory (Washington, DC), and Harvard University (Cambridge, MA).

*On Time*, National Museum of American History, Smithsonian Institution, Washington, DC, 1999

A permanent exhibit that explored the social and technological impact of time keeping on American life from the colonial period to the present day. Clocks and watches were viewed as mirrors and agents of cultural change. The exhibit

examined the economic and social factors that gave clocks primacy over sundials; explored the conflicts between personal and public time; and investigated the colonization of time. [Contributing curator.]

*Under the Sun: An Outdoor Exhibition of Light*, Cooper-Hewitt National Design Museum, New York City, 1998 and the Smithsonian Institution's Enid A. Haupt Garden on the National Mall, Washington, DC, 1999.

A traveling exhibition that explored how designers, planners, architects, artists, and scientists harness solar energy in order to save, expand, and extend energy resources. Central to the exhibition was a solar-powered tensile pavilion that not only collected energy and provided shade, but also served as the gnomon of a magnificent sundial marked on the lawn. Visitors could pace the hours and seasons, and walk through time as they explored this sundial. They were invited to compare solar time and clock time in another featured element: a sundial set in the midst of a circle of 12 solar-powered chairs that signaled hours, minutes, and seconds. In this sundial, it was the visitor's own shadow that marked the hour. [Contributing curator and sundial designer/fabricator.]

*The Universe in Your Hands: Early Tools of Astronomy*, Adler Planetarium & Astronomy Museum, Chicago, IL, from 1995

A new, permanent installation of artifacts from the History of Astronomy Collection intended to afford wide access to the scientific and cultural contexts of the artifacts. This interactive, hands-on exhibition explores the lives and knowledge of European and Islamic astronomers of the Middle Ages. Interpretive elements include evocative tableaux placing artifacts in historical settings; participatory stations offering the visitor an opportunity to use replica instruments; study bays affording in depth treatment of persons or concepts of special historical interest; video programs demonstrating and explaining the functions of certain instruments; primary-source graphics; and label copy. [Chief curator, 1984-1990; planning and implementation supported by grants from the N.E.H.]

*Seeing the Universe*, Adler Planetarium, Chicago, IL, 1990-1999

A permanent exhibit comparing astronomical observatories of the late 19th and late 20th centuries. Features a mock-up of the Dearborn Observatory, Chicago, ca. 1880, with its original refracting telescope (once the world's largest), side-by-side with a modern, working, observing station capable of operating the ARC telescope on Apache Point, New Mexico. With a hands-on telescope micrometer and interactive video.

*A Revolution in Measurement*, Adler Planetarium, Chicago, IL, 1989-1995

An exhibit on the development of the metric system, illustrating how the zeal for reform during the French Revolution extended beyond the political arena to the worlds of commerce and science. Topics included: (1) the social construction of weights and measures; (2) early conventions based on ready-to-hand objects such as barley corns or body parts; (3) scientific and commercial pressures for standardized measures; (4) how the hatred of old class distinctions perhaps spurred French reformers to replace the *pied du roy* with a measure grounded in nature rather than royal authority; (5) Delambre's and Méchain's expeditions to measure the arc of the meridian; (6) slow acceptance of the new metric system and rejection of reforms to calendars and clocks. Two interactive components

compared the old and new systems of measurement. Opening of exhibition coincided with the bicentennial of the French Revolution.

*Isaac Newton, 1687-1987*, Adler Planetarium, Chicago, IL, 1987-1989

Commemorating the tricentennial of the *Principia*'s publication, an exhibition in four parts: (1) Newton's Life and Work; (2) Newton Made Simple: Popularization in the 18th Century; (3) The Prism and the Telescope [relationship of Newton's optical discoveries to his invention of the reflecting telescope]; (4) Mathematical Instruments of Newton's Day.

*Galileo Galilei*, Adler Planetarium, Chicago, IL, 1986-1987

Exploration of Galileo's scientific achievements, his political difficulties and trial. Popular myths exploded by close examination of his books, and facsimiles of his telescope and military geometric compass. Exhibition coordinated with the Goodman Theater's production of Brecht's *Galileo*.

*Bearded Stars: Comets throughout History*, Adler Planetarium, Chicago, IL, 1985-1987

Broadsides, rare books, and artifacts to illustrate how comets were perceived first as signs of divine wrath and then as natural, planetary bodies.

*Eclipses in Historical Perspective*, Adler Planetarium, Chicago, IL, 1984-1985

The fascination and fear of eclipses revealed through early books and artifacts. Emphasis on the use of eclipses to test both basic and complex scientific theories, including the earth's roundness and Einstein's General Theory of Relativity.

*Models of the Universe in the Palm of One's Hand*, Adler Planetarium, Chicago, IL, 1983-1984

Artifacts as examples of the many ways men have modeled their universe. With models men calculated stellar and planetary positions, and instructed others in the world order. Assessment of models as microcosms of the universe, didactic tools for moral education, and symbols of power.

**Class Exhibitions**

As Curator of the Harvard Collection of Historical Scientific Instruments, I work closely with faculty and students in courses where the students collectively mount a temporary exhibition in lieu of writing individual term papers. As a facilitating curator, I mentor the students through the process, coaching them through the physical development, design, and installation phases of their show. Class and student exhibitions have included:

*Thinking Things*
History of Science 290: Critical History: Curating Images, Objects, Media, Spring 2011 – with Professors Peter Galison and Jeffrey Schnapp

*Paper Worlds: Printing Knowledge in Early Modern Europe*
History of Science 215r: Science & Culture in Late Medieval & Early Modern Europe, Spring 2010 – with Professor Katharine Park and Fogg Museum Print Curator Susan Dackerman

*The Matter of Fact 2.0*
History of Science 126: The Matter of Fact, Fall 2009 – with Professor Jimena Canales

*More than Meets the Eye*

HS 134: Nature on Display, Spring 2008 – with Professor Janet Browne

**SARA J. SCHECHNER**

---

## PUBLICATIONS

### Books

*Sundials and Time Finding Instruments: Hour Angle Dials*, Historic Scientific Instruments of the Adler Planetarium, vol. 3 (Chicago: Adler Planetarium, in press 2018).

*Sundials and Time Finding Instruments: Altitude and Azimuth Dials, Astronomical Compendia, and Nocturnals*, Historic Scientific Instruments of the Adler Planetarium, vol. 4 (Chicago: Adler Planetarium, forthcoming 2020).

*Tangible Things: Making History through Objects* (New York: Oxford University Press, 2015), co-authored with Laurel Ulrich, Ivan Gaskell, and Sarah Carter.

*Time and Time Again: How Science and Culture Shape the Past, Present, and Future*, (Cambridge, MA: Collection of Historical Scientific Instruments, 2014). Interactive eBook and PDF available from iTunes, iTunes U, and other sites.

*Comets, Popular Culture, and the Birth of Modern Cosmology* (Princeton: Princeton University Press, 1997; reprinted in paperback, 1999).

### Books Edited

*How Scientific Instruments Have Changed Hands*, Scientific Instruments and Collections, vol. 5 (Leiden: Brill, 2016), edited with Paolo Brenni and Alison D. Morrison-Low.

*Western Astrolabes*, by Roderick S. Webster and Marjorie K. Webster, with introduction by Sara Schechner Genuth, Historic Scientific Instruments of the Adler Planetarium & Astronomy Museum, vol. 1 (Chicago: Adler Planetarium, 1998), edited with Bruce Chandler.

### Essays and Articles

"Telescopes in Colonial and Federal America, 1620-1820" (in preparation).

"Glass and Power: Sourcing Scientific Glass in North America, 1600-1850" (in preparation)

"Inside the Maker's Workshop: Alvan Clark and Robert B. Tolles in the Second Half of the Nineteenth Century" (in preparation with Kenneth Launie).

"Observations on Niccolò Tornioli's *The Astronomers* (in preparation with Susanna Cecilia Berger).

"The Puzzle of a 'Reproduction' Astrolabe in the Style of Jean Fusoris" (in preparation with John Davis).

"Introduction" to *From Celestial to Terrestrial Timekeeping: Clock Making in the Bond Family* by Donald Saff (London: Antiquarian Horological Society, forthcoming 2018).

"Boston Electric: Making Do with 'Mail Order' and Recycled Goods for Teaching and Research at Colonial Harvard," in *Oxford Handbook of History and Material Culture: World Perspectives*, ed. Ivan Gaskell and Sarah Carter (Oxford: Oxford University Press, 2018).

"These Are Not Your Mother's Sundials: Or, Time and Astronomy's Authority," in *The Science of Time 2016: Time in Astronomy & Society, Past, Present and Future*, ed.

Elisa Arias, Ludwig Combrinck, Pavol Gabor, Catherine Hohenkerk, and Kenneth Seidelmann (Cham, Switzerland: Springer International Publishing, 2017).

"The Scientific and Historical Value of Annotations on Astronomical Photographic Plates," *Journal for the History of Astronomy* 47, no. 1 (2016): 3-29, with David Sliski.

"Preservation Recommendations for Historic Photographic Jackets," Appendix III to "The Scientific and Historical Value of Annotations on Astronomical Photographic Plates," *Journal for the History of Astronomy*, 4 Feb. 2016, with David Sliski. http://journals.sagepub.com/doi/suppl/10.1177/0021828615624094.

"The Scientific and Historical Value of Annotations on Astronomical Photographic Plates," *arXiv*, 11 Feb. 2016, with David Sliski.. *https://arxiv.org/abs/1602.03475*.

"European Pocket Sundials for Colonial Use in American Territories," pp. 119 – 170 in *How Scientific Instruments Have Changed Hands*, edited by A. D. Morrison-Low, Sara J. Schechner, and Paolo Brenni, Scientific Instruments and Collections, vol. 5 (Leiden: Brill, 2016).

"The Art of Making Leyden Jars and Batteries According to Benjamin Franklin," *eRittenhouse* 26 (2015). http://www.erittenhouse.org/articles/vol-26-contents-and-authors/making-leyden-jars-and-batteries/

"Instrumentation," pp. 408-419 in *A Companion to the History of American Science*, ed. Georgina M. Montgomery and Mark A. Largent (Chichester: Wiley Blackwell, 2015).

"Tortoises Sail the Sea," *Wonders and Marvels*, 31 July 2015. *http://www.wondersandmarvels.com/2015/07/tortoises-sail-the-sea.html*.

"How Telescopes Came to New England, 1620-1740," pp. 69-78 in *Scientific Instruments in the History of Science: Studies in Transfer, Use and Preservation*, ed. Marcus Granato and Marta C. Lourenço (Rio de Janeiro: Museu de Astronomia e Ciências Afins (M.A.S.T.), 2014). In print and eBook at http://www.mast.br/scientific_instruments_in_the_history_of_science_studies_in_transfer_use_and_preservation.html.

"Webster Memories," pp. 62-67 in *Rod and Madge Webster: A Legacy of Collections, Philanthropy, and Friendship*, ed. Marvin Bolt et al. (Chicago: Adler Planetarium, 2014).

"David P. Wheatland (1898-1993): Scholar, Author, Avid Collector, *Sine qua non* for the Collection of Historical Scientific Instruments." Collection of Historical Scientific Instruments, Harvard University, 2012. http://chsi.harvard.edu/chsi_wheatland.html.

"Division IX/Commission 41/Working Group Historical Instruments." *Proceedings of the International Astronomical Union* 7, no. T28A (2011): 400-402.

"IAU Historical Instruments Working Group: Triennial Report (2009-2011)," *Journal of Astronomical History and Heritage* 14 (2011): 235-236.

"Did Early Renaissance Painters Trace Optically Projected Images? The Conclusion of Independent Scientists, Art Historians, and Artists," pp. 215-242 in *Digital Imaging for Cultural Heritage Preservation: Analysis, Restoration, and Reconstruction of Ancient Artworks* (Boca Raton, FL: CRC Press, Taylor & Francis Group, 2011), with David G.

Stork et al.

"Materialna kultura astronomii w życiu codziennym: zegary słoneczne, nauka i przemiany społeczne." ("The Material Culture of Astronomy in Daily Life: Sundials, Science and Social Change.") Translated into Polish by Darek Oczki. GNOMONIKA.pl: Zegary słoneczne, czyli słoneczniki. Last modified December 28, 2011. http://gnomonika.pl/news.php?id=54, http://gnomonika.pl/news.php?id=59, http://gnomonika.pl/news.php?id=62.

"The Adventures of Captain John Smith Among the Mathematical Practitioners: Cosmology, Mathematics, and Power at the Time of Jamestown," *Rittenhouse: Journal of the Scientific Instrument Enterprise*, special issue: Science and Early Jamestown, 21, no. 2 (2007): 126-144.

"Astrolabes and Medieval Travel," pp. 181-210 in *The Art, Science, and Technology of Medieval Travel*, AVISTA Studies in the History of Medieval Technology, Science and Art (Aldershot, UK: Ashgate, 2008).

"New Worlds, New Scientific Instruments: Cosmology, Mathematics, and Power at the Time of Jamestown," pp. 229-239 in *The World of 1607*, catalog of an exhibition at the Jamestown Settlement, 2007-2008 (Williamsburg: Jamestown-Yorktown Foundation, 2008).

"The Adventures of Captain John Smith, Pocahontas, and a Sundial," *The Compendium* 14, no. 1 (2007): 19-24.

"The Adventures of Captain John Smith, Pocahontas, and a Sundial," pp. 65-72 in *East and West: The Common European Heritage*, Proceedings of the XXV Scientific Instrument Symposium (Krakow: Jagiellonian University Museum, 2006).

"Benjamin Franklin and a Tale of Two Electrical Machines," pp. 33-40 in *Benjamin Franklin: A How-To Guide*, a special issue of the *Harvard Library Bulletin* 17, nos. 1-2 (spring-summer 2006).

"Benjamin Franklin: A How-To Guide, Catalog of the Exhibition," pp. 47-99 in *Benjamin Franklin: A How-To Guide*, a special issue of the *Harvard Library Bulletin* 17, nos. 1-2 (spring-summer 2006), with Joyce Chaplin and Thomas Horrocks.

"Astrolabes and the Medieval Traveler," *AVISTA Forum Journal* 16, no. 1/ 2 (Fall 2006): 30-32.

"Between Knowing and Doing: Mirrors and Their Imperfections in the Renaissance," in *Optics, Instruments and Painting, 1420-1720: Reflections on the Hockney-Falco Thesis*, a special issue of *Early Science and Medicine* 10 (2005): 137-162.

"Museum Education and Instruction on the History and Nature of Science," pp. 78-94, in *Partners in Innovation: Science Education and the Science Workforce*, ed. Regina L. Blaszczyk (Philadelphia: Chemical Heritage Press, 2005).

"Harvard's Collection of Historical Scientific Instruments and Its Astronomical Treasures," *Journal of Astronomical History and Heritage* 7 (2004): 59-60.

"Against the Hockney-Falco thesis: Glass and metal mirrors of the 15th century could not project undistorted images," *Technical Digest: Frontiers in Optics 2004*, 88th OSA Annual Meeting (Washington, DC: Optical Society of America, 2004).

"Ancient Cosmologies," in *Beyond Earth: Mapping the Universe*, ed. David DeVorkin (Washington, DC: National Geographic, 2002), 12-29.

"The Material Culture of Astronomy in Daily Life," *Journal for the History of Astronomy* 32 (2001): 189-222.

"The Time of Day: Marking the Sun's Passing," pp. 120-139, in *The Discovery of Time*, ed. Stuart McCready (London: MQ Publications, 2001).

"A Phoenix of Human Nature," in *Science and Creation: The Riddle of the Skies*, a special issue of *UNESCO Courier* 54, no. 5 (May 2001): 16.

"Art in the St. Petersburg Observatory: Putti with Scientific Instruments," *Bulletin of the Scientific Instrument Society* 64 (2000): 2, cover story.

"Looking Back to the Beginning: The AAS at 100," pp. 2-3, in *American Astronomical Society 1999 Membership Directory–The Centennial Year* (Washington, DC: American Astronomical Society, 1998).

"Astrolabes: A Cross-Cultural and Social Perspective," pp. 2-25, in *Western Astrolabes*, Historic Scientific Instruments of the Adler Planetarium & Astronomy Museum, vol. 1, ed. Sara Schechner Genuth with Bruce Chandler (Chicago: Adler Planetarium, 1998).

"Floating Sundials from Down Under," *The Compendium* 4, no. 3 (1997): 1-7, with Robert Terwilliger and Norman Heckenberg.

"Tools for Teaching and Research: John Prince, the Deerfield Academy, and Educational Reform in the Early Republic," *Rittenhouse* 10 (1996): 97-120.

"What Is This Sundial?" [invited critique of an early modern sundial], *NAWCC Bulletin* (August 1996): 522.

"A Small Compass Sundial," *NAWCC Bulletin* (June 1996): 389-390.

"Astronomical Imagery in a Passage of Homer," *Journal for the History of Astronomy* 23 (1992): 293-298.

"Devils' Hells and Astronomers' Heavens: Religion, Method, and Popular Culture in Speculations about Life on Comets," pp. 3-26, in *The Invention of Physical Science: Intersections of Mathematics, Theology and Natural Philosophy since the Seventeenth Century. Essays in Honor of Erwin N. Hiebert*, ed. Mary Jo Nye, Joan L. Richards, and Roger H. Stuewer (Dordrecht: Kluwer Academic Publishers, 1992).

"From Heaven's Alarm to Public Appeal: Comets and the Rise of Astronomy at Harvard," pp. 28-54, in *Science at Harvard University: Historical Perspectives*, ed. Clark A. Elliott and Margaret W. Rossiter (Bethlehem: Lehigh University Press, 1992; London: Associated University Presses, 1992)

"Newton and the Ongoing Teleological Role of Comets," pp. 299-311, in *Standing on the Shoulders of Giants: A Longer View of Newton and Halley*, ed. Norman J. W. Thrower (Berkeley: University of California Press, 1990).

"Blazing Stars, Open Minds, and Loosened Purse Strings: Astronomical Research and Its Early Cambridge Audience," *Journal for the History of Astronomy* 21 (1990): 9-20.

"Blazing Stars, Open Minds, and Loosened Purse Strings: Astronomical Research and Its Early Cambridge Audience," in *Two Astronomical Anniversaries: HCO & SAO*, ed. Owen Gingerich and Michael Hoskin (Chalfont St. Giles, England: Science History Publications for the Harvard-Smithsonian Center for Astrophysics, 1990).

"Comets, Teleology, and the Relationship of Chemistry to Cosmology in Newton's Thought," *Annali dell'Istituto e Museo di Storia della Scienza di Firenze* 10, fascicolo 2 (1985): 31-65.

"John Prince and Early American Scientific Instrument Making," pp. 431-503, in *Sibley's Heir: A Volume in Memory of Clifford Kenyon Shipton*, ed. Frederick S. Allis, Jr. and Philip C. F. Smith, Publications of the Colonial Society of Massachusetts, no. 59 (Boston: Colonial Society of Massachusetts, 1982).

"Science in the Context of Tradition: Solomon Maimon and Samson Raphael Hirsch," *Synthesis* 4, no. 2 (1977): 28-43.

Articles in *The Adler Planetarium Newsletter* include "Bearded Stars in Science and Satire" (1986); "Fear and Frolic in 1910: Chicago's Reaction to Halley's Comet" (1985); "Books with Moving Parts" (1984); "A Renaissance 'Pocket Watch'" (1984); "Past Sightings of Comet Halley" (1984).

Essays on the scientific and social context of diverse scientific instruments have appeared in seven annual reports of the Adler Planetarium (1983-1989). Featured instruments included a Rittenhouse surveyor's compass, a Heath grand orrery, a Blaeu celestial globe, a Schissler astronomical compendium, an Arsenius astronomical ring, a mariner's astrolabe from the *Atocha*, and a Lenoir reflecting circle.

**Entries in Encyclopedias**

"Almanacs," in *The History of Science in the United States: An Encyclopedia*, ed. Marc Rothenberg (New York: Garland, 2001).

"Boston Philosophical Society (1683)," in *The History of Science in the United States: An Encyclopedia* (2001).

"Sciences in America: Colonial Period to 1789," in *The History of Science in the United States: An Encyclopedia* (2001).

"Brown, Joseph" in *American National Biography*, ed. John A. Garraty (Cary, NC: Oxford University Press, 1999).

"West, Benjamin," in *American National Biography* (1999).

"Comets and Meteors," in *The History of Science and Religion in the Western Tradition: An Encyclopedia*, ed. Gary B. Ferngren et al. (New York: Garland, 2000).

"Armillary Sphere," in *Instruments of Science: A Historical Encyclopedia*, ed. Robert Bud and Deborah Warner (New York: Garland, 1998).

"Armillary Sphere," in *History of Astronomy: An Encyclopedia*, ed. John Lankford (New York: Garland, 1997).

"Astrolabe," in *History of Astronomy: An Encyclopedia* (1997).

"Atlases, Astronomical," in *History of Astronomy: An Encyclopedia* (1997).

"Constellations," in *History of Astronomy: An Encyclopedia* (1997).

"Cross-Staff," in *History of Astronomy: An Encyclopedia* (1997).

"Globes, Celestial," in *History of Astronomy: An Encyclopedia* (1997).

"Mural Quadrant," in *History of Astronomy: An Encyclopedia* (1997).

"Octant," in *History of Astronomy: An Encyclopedia* (1997).

"Sundials," in *History of Astronomy: An Encyclopedia* (1997).

**Abstracts**

"The Future of Astronomy's Archived Observations –An Open Discussion," *Bulletin of the American Astronomical Society* 50, no. 7 (2018).

"Issues and Challenges in the Protection of Different Categories of Astronomical Heritage: A Report from Beijing 2012," *American Astronomical Society Meeting Abstracts*, vol. 221 (2013).

"Preservation Challenges in North America: Recent Efforts by the American Astronomical Society," *C41/ICHA Science Meetings at the IAU XXVIII General Assembly*, 1 (2012): 49.

"Astronomy behind Enemy Lines: Colonial American Field Expeditions, 1761—1780," *C41/ICHA Science Meetings at the IAU XXVIII General Assembly*, 1 (2012): 27.

"Early American Telescopes," *Bulletin of the American Astronomical Society* 41, no. 1 (2009): 186.

"The Adventures of Captain John Smith, Pocahontas, and a Sundial: Cosmology, Mathematics, and Power at the Time of Jamestown," *Bulletin of the American Astronomical Society* 39, no. 4 (2007): 786.

"The Adventures of Captain John Smith, Pocahontas, and a Sundial," in *East and West: The Common European Heritage*, Book of Abstracts of the XXV Scientific Instrument Symposium (Krakow: Jagiellonian University Museum, 2006).

"Astronomy behind Enemy Lines in Colonial North America: John Winthrop's Observations of the Transits of Venus," *Bulletin of the American Astronomical Society* 37, no. 4 (2005): 1241.

"Time Well Spent: Early Modern Sundials as Evidence of Time Pressures and Consumer Culture," *XVIII International Scientific Instrument Symposium: Abstracts and Materials* (Moscow: 1999), 27.

"From Heaven's Alarm to Public Appeal: Comets and the Rise of Astronomy at Harvard," *History of Physics Newsletter* 5, no. 5 (1994): 86.

"Blazing Stars, Open Minds, and Loosened Purse Strings: Astronomical Research and Its Early Cambridge Audience," *Bulletin of the American Astronomical Society* 20, no. 4 (1988): 947.

"The Teleological Role of Comets in 17th and 18th Century Natural Philosophy," *Bulletin*

*of the American Astronomical Society* 16, no. 2 (1984): 476-477.

**Book Reviews**

"'Girl Hours' at the Harvard College Observatory," review of *The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars*, by Dava Sobel, *Journal for the History of Astronomy* (forthcoming 2018).

*Astrolabes from Medieval Europe* by David A. King, essay review in *Aestimatio* 11 (2014): 354-363.

"Historical Instruments in the Mikulov Collections," review of *Historické vědecké přístroje v mikulovských sbírkách: Katalog vědeckých přístrojů z 16. až 19. století ve sbírkách Regionálního muzea v Mikulově* [*Historical Scientific Instruments in the Mikulov Collections: Catalogue of Scientific Instruments from the 16th to 19th Centuries in the Collection of the Regional Museum in Mikulov*] by Zdeněk Horsky, *Journal for the History of Astronomy* 45 no.1 (2014): 134-135.

"An American of Many Lives," review of *Two Brides for Apollo: The Life of Samuel Williams, 1743-1817*, by Robert F. Rothschild, *Journal for the History of Astronomy* 43, no. 1 (2012): 122-123.

*Eastern Astrolabes*, by David Pingree, essay review in *Aestimatio* 7 (2010): 7-11.

*Eastern Astrolabes*, by David Pingree, *HAD News*, no. 76 (April 2010): 6-7.

*Elizabethan Instrument Makers: The Origins of the London Trade in Precision Instrument Making*, by Gerard L'E. Turner, *Isis* 97 (2006): 743.

"Comets: Sublunary or Celestial?" Review of *The Age of Two-Faced Janus: The Comets of 1577 and 1618 and the Decline of the Aristotelian World View in the Netherlands*, by Tabitta van Nouhuys, *Journal for the History of Astronomy* 34 (2003): 118-119.

"The Many Facets of Halley," review of *Edmond Halley: Charting the Heavens and Seas, by Alan Cook, Journal for the History of Astronomy* 31, no. 2 (2000): 73-74.

"Too Little Dirty Linen," essay review of *Galileo's Daughter: A Historical Memoir of Science, Faith, and Love*, by Dava Sobel, *The World & I* 15 (April 2000): 262-267.

"The Gerard Turner *Festschrift."* Review of *Making Instruments Count*, ed. R. G. W. Anderson, J. A. Bennett, and W. F. Ryan, *Journal for the History of Astronomy* 27 (1996): 176-177.

*The Lord of Uraniborg: A Biography of Tycho Brahe*, by Victor E. Thoren, *History of European Ideas* 17 (1993): 690-691.

*Comets: A Chronological History of Observation, Science, Myth, and Folklore*, by Donald K. Yeomans, *Isis* 83 (1992): 468-469.

*Le Citoyen Lenoir: Scientific Instrument Making in Revolutionary France* (exhibition catalogue), by J. A. Bennett, *Isis* 83 (1992): 141-142.

*From Pleasure and Profit to Science and Security: Etienne Lenoir and the Transformation of Precision Instrument-Making in France, 1760-1830*, by A. J. Turner, *Isis* 83 (1992): 141-142.

"Comets and Their Malevolence," review of *The Origin of Comets*, by M. E. Bailey, S. V. M. Clube, and W. M. Napier, *Journal for the History of Astronomy* 23 (1992): 215-217.

*Union Catalogue of Printed Books of the Fifteenth, Sixteenth, and Seventeenth Centuries in European Astronomical Observatories*, ed. Giovanna Grassi, *Isis* 82 (1991): 419.

"Biography of Maskelyne," review of *Nevil Maskelyne: The Seaman's Astronomer*, by Derek Howse, *Journal for the History of Astronomy* 21 (1990): 380-381.

"Nineteenth Century Scientific Apparatus," review of *Pike's Illustrated Catalogue of Scientific & Medical Instruments*, by Benjamin Pike, Jr., *Journal for the History of Astronomy* 18 (1987): 140-141.

*Hubble Time*, by Tom Bezzi, *The Chicago Tribune*, November 1987.

"Three Harbingers of Halley's Comet," essay review of *The Mystery of Comets*, by Fred L. Whipple, *Comet*, by Carl Sagan and Ann Druyan, and *Fire and Ice: A History of Comets in Art*, by Roberta J. M. Olson, *The Chicago Tribune Book World*, 8 December 1985.

**Online Resources**

Waywiser, http://dssmhi1.fas.harvard.edu/emuseumdev/code/eMuseum.asp?lang=EN, the online database of the Collection of Historical Scientific Instruments, Department of the History of Science, Harvard University. Contributor of 1000s of object entries and biographies, particularly in the areas of astronomy, microscopy, optics, time finding, surveying, and navigation. Developed with Jean-François Gauvin, 2007-2008.

Transits of Venus, http://transits.mhs.ox.ac.uk/, a global collaboration of institutions holding historical scientific instruments, images, and documents used on Transit of Venus expeditions in the 18th and 19th centuries, creating a database of instruments, observing stations, events, people, and institutions. Developed with Stephen Johnston and Steven Turner, 2003-2004.

**INVITED LECTURES**

"Sundials that Tell More than the Time," 2018 Andrew Somerville Memorial Lecture to the British Sundial Society, Norwich, UK, April 2018.

"Tangible Things of American Astronomy," 2018 LeRoy E. Doggett Prize for Historical Astronomy plenary lecture at the annual meeting of American Astronomical Society, National Harbor, MD, January 2018. Also delivered at the Harvard Museums of Science and Culture, Cambridge, MA, March 2018.

"Time in the Wilderness: European Pocket Sundials Used in Colonial America," invited talk at the meeting of the British Sundial Society, Oxford, UK, April 2017.

"These Are Not Your Mother's Sundials, Or, Time and Astronomy's Authority," talk given at the Science of Time 2016 Symposium, Harvard University, June 2016.

"On Preserving Annotations on Astronomical Plates and Their Enclosures," talk delivered at AstroPlate 2016, held at the Astronomical Institute of the Academy of Science of the Czech Republic, Prague, March 2016.

"Glass and Power: Sourcing Scientific Glass in North America, 1600-1850," talk given at the XXXIV Symposium of the IUHPS Scientific Instrument Commission, held in Turin, Italy, September 2015. Also delivered at the meeting of the Antique Telescope Society at Lick Observatory, Mount Hamilton, CA, October 2015.

"These Are Not Your Mother's Sundials," lecture at Stellafane, Springfield, VT, August 2015.

"Time and Astronomy's Authority," talk and hands-on session with sundials at the Biennial History of Astronomy Workshop, Notre Dame and the Adler Planetarium, June 2015.

"Cabinets of Curiosity and a New *Case for Curiosity*," delivered during the Object Lab, Chipstone Foundation, Milwaukee, June 2015.

"Boston Patriots and the Transit of Venus," talk given at the Union Club, Boston, March 2015.

"Metamorphosis," a joint presentation by Sara Schechner and Ralph Helmick for Catalyst Conversations, an art-and-science dialogue at the Broad Institute, Cambridge, November 2014.

"Galileo's Geometrical and Military Compass: Job Hunting like an Engineer," talk and hands-on session with replica instrument as part of Galileo 450$^{th}$ Anniversary, Boston University Center for Philosophy and History of Science, with Harvard's History of Science Department, Boston and Cambridge, October 2014.

"More a Workshop than a Factory: A Look at Alvan Clark and Sons" (with Kenneth Launie), talk at the XXXIII Symposium of the IUHPS Scientific Instrument Commission, held in Tartu, Estonia, September 2014.

"Obsolete and Discarded Things: A Tale of Two Electrical Machines: Making Do in Colonial Boston," presented at the workshop, History and Material Culture: World Perspectives, at the Bard Graduate Center, New York, May 2014.

"On Making the Exhibition *Body of Knowledge*," a panel discussion at the History of Science Department Colloquium, April 2014.

"R. Newton Mayall and the Sundials at Harvard," presented at the meeting of the North American Sundial Society, Cambridge, August 2013.

"Trading in Time: European Pocket Sundials Designed for Colonial Use in American territories," talk delivered at the XXXII Scientific Instrument Symposium, which formed part of the 24th International Congress of History of Science, Technology, and Medicine, Manchester, UK, July 2013.

"What Galileo Saw and How: Glass and its Challenges for 17th Century Telescope Makers," colloquium workshop delivered to the Indiana University Department of History and Philosophy of Science, Bloomington, March 2012.

"Tigers, Teapots, Telegraphs – Thoreau's Turtle – and a Hundred-year-old Tortilla: Scientific Instruments in the World of Tangible Things," talk at the XXX Symposium of the IUHPS Scientific Instrument Commission, held at the Cabinet of Astronomy and Physics, Museumslandschaft Hessen-Kassel, September 2011.

"Politics and the Dimensions of the Solar System: John Winthrop's Observations of the Transit of Venus," invited lecture as part of "The Royal Society and the British Atlantic World," Royal Society, London, October 2010. Also delivered at Stellafane Convention, Springfield, VT, August 2011; at Mount Wilson Observatory during the Transit of Venus, June 2012; and the Astronomers' Conjunction, Northfield, MA, July 2012.

"What Galileo Saw and How: Glass and its Challenges for 17th Century Telescope Makers," lecture and hands-on workshop delivered as part of the Paul and Irene Hollister Seminar on Glass, Bard Graduate Center, March 2010.

"Counterfeits, Copycats, and Knockoffs in the Branding and Selling of Scientific Instruments," talk delivered in the symposium, "How Instruments Change Hands," organized by Sara Schechner and Allison Morrison-Low for the XXIII International Congress of History of Science and Technology, Budapest, July 2009.

"Telescopes in Colonial & Federal America, 1620-1820," invited talk at the Stellafane Convention / Hartness House History of Astronomy Workshop 2009, Springfield, VT, August 2009, and in a special session of the American Astronomical Society, Long Beach, CA, January 2009, and to the Antique Telescope Society, Ann Arbor, MI, May 2009. Later delivered at the XXXI Scientific Instrument Symposium of the IUHPS Scientific Instrument Commission, Rio de Janeiro, October 2012.

"A Matter of Time: Sundial Iconography in Art, Literature and Music," invited talk in the session, "Picturing Instruments: Case Studies in Iconography," at the XXVII Symposium of the IUHPS Scientific Instrument Commission, Lisbon, September 2008.

"Prints and the Production of Knowledge in Early Modern Europe: The Case of Scientific Instruments," panel discussion organized by the Humanities Center at Harvard, May 2007.

"Pocket Sundials and the Savvy Traveler," colloquium delivered at Columbia University in affiliation with the New York Academy of Sciences, November 2006.

"The Adventures of Captain John Smith, Pocahontas, and a Sundial," talk delivered to the IUHPS Scientific Instrument Commission, Krakow, September 2006, with longer versions presented at a special session of the American Astronomical Society, Austin, January 2008 and to the Amateur Telescope Makers of Boston, May 2008.

"Astrolabes and the Medieval Traveler," invited talk and hands-on workshop presented at the 41st International Congress on Medieval Studies, Kalamazoo, MI, May 2006.

"Three Curators, Two Venues, One Exhibition: The Process of Creating *Benjamin Franklin: A How-To Guide*," keynote talk at the Librarians' Assembly, Harvard University, May 2006.

"Building a New Museum at Harvard and a Bridge between Science and the Arts," talk delivered at the New York Academy of Sciences at the request of the History and Philosophy of Science Section, November 2005, and as the Donald Hamingson Memorial Lecture, Maplewood, NJ, April 2005.

"Between Knowing and Doing: Mirrors and Their Imperfections in the Renaissance," talk delivered at the Symposium on Optics and Renaissance Painting, during the annual meeting of the Optical Society of America, Rochester, October 2004.

"Politics, Instruments, and the Dimensions of the Solar System: John Winthrop's Observations of the Transits of Venus in 1761 and 1769," the Helen Sawyer Hogg Public Lecture of the Royal Astronomical Society of Canada, St. John's, Newfoundland, July 2004. Versions of this talk were also delivered in Dresden to the IUHPS Scientific Instrument Commission and at Harvard University in 2004.

"Sundials of Newfoundland," talk delivered at the annual meeting of the North American Sundial Society, Tenafly, NJ, August 2004.

"Museum Education: Using Historical Scientific Instruments to Teach Science, History, and the Arts," talk and workshop at the international conference, "Scientific Instrument Collections in the University," Hanover, NH, June 2004.

"Doing It with Lenses and Mirrors: Recovering the Methods of Art and Science from Historical Instruments," talk delivered at the Plenary Session, "The Material World of Science, Art, Books, and Body Parts," at the annual meeting of the History of Science Society, Milwaukee, November 2002.

"Savvy Travelers and Their Portable Sundials," presented at the North American Sundial Society meeting, Tuscon, September 2002.

"Doing It with Lenses and Mirrors: Recovering the Methods of Art and Science from Historical Instruments," an assessment of David Hockney's thesis at *Do Collections Matter for Instrument Studies*, a conference sponsored jointly by the Scientific Instrument Commission of the International Union of the History and Philosophy of Science and the British Society for the History of Science, Oxford, June 2002.

"The Material Culture of Astronomy in Daily Life: Sundials, Science, and Social Change," invited paper at the History of Science Society meeting in Vancouver, November 2000.

"History of Science on Display: Exhibits as Venues for Science-and-Society Issues," talk delivered at the New York Academy of Sciences at the request of the Physics,

Astronomy, and History and Philosophy of Science Sections, April 2000.

"Time Well Spent: Early Modern Sundials as Evidence of Time Pressures and Consumer Culture," delivered at *On Time: History, Science, Commemoration*, a conference organized by the British Society for the History of Science, the Royal Historical Society, and the National Museums & Galleries on Merseyside, Liverpool, September 1999; and also presented at the XVIII International Scientific Instrument Symposium held in Moscow and St. Petersburg, September 1999.

"A Russian Cube Sundial at the Adler Planetarium & Astronomy Museum in Chicago," paper discussed at the annual meeting of the Scientific Instrument Commission of the International Union of the History and Philosophy of Science, Moscow, September 1999.

"Faith in Time: Sundials and Religion," invited paper presented at the fourth Biennial History of Astronomy Workshop, Notre Dame, July 1999; and at the annual meeting of the North American Sundial Society, Hartford, CT, October 1999.

"*Under the Sun* Outreach: Discovering Time," paper presented at the annual meeting of the North American Sundial Society, Hartford, CT, October 1999.

"*Under the Sun*: Designing Sundials for the Cooper-Hewitt National Design Museum," presented at the annual meeting of the North American Sundial Society, Seattle, September 1998.

"Comets, Monsters, and Signs of the Times," delivered at UW Space Place, Madison, October, 1997.

"Early Modern Sundials as Evidence of Consumer Culture," invited paper presented at the third Biennial History of Astronomy Workshop, Notre Dame, June 1997.

"Astrolabes: A Cross-Cultural and Social Perspective," delivered at the New York Academy of Sciences, May 1997, and at the annual meeting of the North American Sundial Society, Chicago, September 1997.

"Popular Culture and Elite Cosmology in Early Modern England," colloquium presented to the Department of the History of Science, Medicine, and Technology, Johns Hopkins, February 1997.

"Scientific Models and Political Realities," delivered at a Smithsonian Institution Libraries luncheon, National Museum of Natural History, February 1997.

"Models and the Order of the World," colloquium given at the National Museum of American History, November 1996.

"Historic Sundials as Evidence of Consumer Culture," delivered at the annual meeting of the North American Sundial Society, Toronto, September 1996.

"Tools for Teaching and Research in an Early Nineteenth-Century American Academy," delivered at the annual meeting of the Scientific Instrument Commission of the International Union of the History and Philosophy of Science, Ottawa, September 1996.

"Popular Culture and Elite Cosmology in Early Modern England," colloquium sponsored by the Committee on the History and Philosophy of Science, University Maryland at College Park, April 1995.

"Popular Culture and Elite Cosmology," delivered at the annual meeting of the History of Science Society, New Orleans, October 1994.

"Scientific Instruments as Evidence of Consumer Culture," presented at the XIII Scientific Instrument Symposium, sponsored at the Museum Boerhaave by the Scientific Instrument Commission of the International Union of the History and Philosophy of Science, Leiden, September 1994.

"Astronomy in Social Context during the Scientific Revolution," presented at the first Biennial History of Astronomy Workshop, Notre Dame, June 1993.

"Signs of the Times: Comets, Popular Culture, and World Affairs," delivered at the New York Academy of Sciences, May 1992.

"Providence, Politics, and Astrophysics," delivered as part of the Saturday Series at the Newberry Library, Chicago, March 1991.

"Signs of the Times: Pictorial Sources as Evidence of Shifting Perceptions of Comets," delivered at a Newberry Library Colloquium, February 1991.

"Models of the Universe in the Palm of One's Hand," delivered at the annual meeting of the History of Science Society, Seattle, October 1990.

"Scientific Theory Made Manifest in Instrument Design," delivered at the annual meeting of the Scientific Instrument Commission of the International Union of the History and Philosophy of Science, Washington, Boston, and Cambridge, September 1990.

"Blazing Stars, Open Minds, and Loosened Purse Strings: Astronomical Research and Its Early Cambridge Audience," delivered at the symposium, "Astronomy in Cambridge," celebrating the sesquicentennial of the Harvard College Observatory and the centennial of the Smithsonian Astrophysical Observatory, Cambridge, January 1989.

"Science and Ethics: Galileo and Brecht," paper and panel discussion organized by the Goodman Theater, Chicago, to coincide with a performance of Brecht's *Galileo*, October 1986.

"Halley's Comet Theory, Noah's Flood, and the End of the World," joint workshop of the Fishbein Center for History of Science and Medicine and the Conceptual Foundations of Science, University of Chicago, January 1986.

"From Monstrous Signs to Natural Causes: Halley's Theory of Comets," colloquium of the Center for the Interdisciplinary Study of Science and Technology, Northwestern University, January 1986.

"Newton and the Ongoing Teleological Role of Comets," delivered at a conference, "Newton and Halley, 1686-1986," hosted by the William Andrews Clark Memorial Library, U.C.L.A., August 1985.

"The Tut-ankh-Amun Astronomical Instrument [*merkhet*] and the Cycle of Birth, Death, and Rebirth in Egyptian Cosmology," featured-object lecture, Oriental Institute, University of Chicago, April 1985.

"From Monstrous Signs to Natural Causes: The Assimilation of Comet Lore into 17th and 18th Century Natural Philosophy," delivered at the annual meeting of the History of Science Society, Chicago, December 1984.

"The Teleological Role of Comets in 17th and 18th Century Natural Philosophy," delivered at the 164th meeting of the American Astronomical Society, Baltimore, June 1984.

"The Influence of Theory on Instrument Design: The Case of Hauksbee's Friction Electric Machine," delivered at the annual meeting of the History of Science Society, Los Angeles, December 1981.

**HANDS-ON WORKSHOPS**

*Materials Lab Workshop: Optical Devices in Science and Art in Early Modern Times*, Cambridge, MA, December 2017

Developments in optics in the 17th through the early 19th centuries enabled scientists and artists to extend their sense of sight and make visible wondrous things that the naked eye had not before seen. The telescope revealed a universe teeming with worlds, while the microscope showed every drop of water to be crammed full of beings and things. Soon new projection equipment such as magic lanterns and solar microscopes threw images on walls to amuse and educate social groups of people. The camera obscura and camera lucida also offered Vermeer and Ingres, respectively, new methods for copying and scaling scenes, although these tools did not make their painting easier.

In this hands-on workshop, I guided participants in an exploration of optical instruments employed for art, science, and entertainment. I discussed how the quality of lenses, mirrors, and glass had an impact on when and how artists might have benefited from optical instruments such as the camera obscura and lucida. Participants then joined me and Francesca Bewer, research curator for conservation and technical studies at the Harvard Art Museums, to construct their own camera obscuras, and try their hands at drawing with it or a camera lucida.

This program was held in the Materials Lab of the Harvard Art Museums and in the Harvard Collection of Historical Scientific Instruments in conjunction with the exhibitions *The Philosophy Chamber: Art and Science in Harvard's Teaching Cabinet, 1766–1820* and *Scale: A Matter of Perspective.*

*Electrical Fire! A Course of Experiments Performed for the Curious in the Philosophy Chamber*, Cambridge, MA, *October 2017*

Ever wonder what it was like to attend Harvard College in the mid-1700s? Using vintage and replica scientific instruments, Daniel Rosenberg, a lecture demonstrator, and I recreated 18th century electrical experiments straight out of the lecture notes of Professor John Winthrop. Spectators witnessed the surprising effects of electrical attraction and repulsion! A fire lit by water! Bells rung by an invisible, imponderable fluid! And a warning to all who do not have lightning rods: the blowing up of the Thunder House!

This program was sponsored by the Collection of Historical Scientific Instruments, the Harvard Museums of Science and Culture, the Harvard Art Museums (in conjunction with the Philosophy Chamber exhibition), and USW30: Tangible Things: Harvard Collections in World History.

*Seriously Amazing Objects: Project Moonwatch*, Smithsonian Channel, filmed in Boston and Cambridge, July 2017

Featuring Project Moonwatch telescopes that belonged to the Smithsonian Astrophysical Observatory and its director, Fred Whipple, this segment of the Smithsonian Channel's *Seriously Amazing Objects* told the story of citizen scientists who tracked Sputnik and other artificial satellites during the International Geophysical Year of 1957-1958.

Filming took place at the Harvard Collection of Historical Scientific Instruments and the Harvard- Smithsonian Center for Astrophysics. I was the on-camera expert who discussed the project and instruments with a school teacher and former Moonwatch participant.

*Transit of Mercury*, Cambridge, MA, May 2016

I arranged for the viewing of the Transit of Mercury on May 9, 2016 with historic and modern telescopes on the rooftop of the Harvard College Observatory. Participants included the Astronomer Royal of Scotland, astronomers and staff of the Harvard-Smithsonian Center for Astrophysics, and members of the History of Science Department.

*Revolutionary Science: Natural Philosophical Demonstrations circa 1775*, Cambridge Science Festival, Cambridge, MA, Patriots' Day, April 18, 2016.

Drawing from demonstration lectures at Harvard College and Faneuil Hall, Boston in the 1700s, this event recreated electrical experiments popularized by Benjamin Franklin. Experiments were performed in period costume with vintage and replica instruments by Sara Schechner and Daniel Rosenberg, a lecture demonstrator. Rare 18th-century apparatus from the Collection of Historical Scientific Instruments was also on display during the lecture. This was a featured family program on Patriots' Day during the Cambridge Science Festival.

*NAWCC Horological Workshop on Astronomical Clocks*, Cambridge, MA, October 2015.

In this day-long program at Harvard's Collection of Historical Scientific Instruments, regional members of the National Association of Watch and Clock Collectors studied clockwork mechanisms, including a grand orrery, and the working movements of precision clocks used by astronomers from 1685 until the early 20th century. Of particular interest were the astronomical regulators by William Bond & Son that delivered standard time from the Harvard College Observatory to regional railroads. Organized with horologists Richard Ketchen and John Losch.

*Hands-On Astrolabes!* Cambridge, MA, 2015

Three independent workshops for Harvard undergraduates and graduate students in which everyone made their own astrolabe and learned how to use it.

*Lighthouses of the Skies*, Adams National Historical Park, Quincy, MA, October 2014

This day-long program focused on John Quincy Adams and his interest in the sciences, particularly astronomy. I helped park rangers identify his astronomical instruments in advance of their being exhibited at the event. I offered a make-your-own sundial workshop.

*Galileo's Maculate Sun: Solar Astronomy Then and Now*, Cambridge, MA, October 2013

2013 marked the 400th anniversary of Galileo Galilei's book on sunspots. We invited middle and high school teachers to a Teacher Professional Development Program at the Collection of Historical Scientific Instruments. They learned how Galileo discovered these "smudges" on the sun, and why they are important to astronomy. In a full day of varied activities, we explored the history, science, art, and technology of solar research. The teachers learned new ways to teach astronomical concepts, viewed

live sunspots, and participated in a telescope-building activity that they could replicate with their students. Organized with Owen Gingerich and support from the Harvard Museum of Natural History.

*Summer Solstice at the Harvard Museums of Science and Culture*, Cambridge, MA, June 21, 2013 and subsequent years

This celebration of the longest day of the year included live music, ice cream, hands-on activities, and free admission to all four of the Harvard Museums of Science and Culture. Close to 5000 people participated. As a principal member of the planning team, my focus was on astronomy activities and entertainment. I created a human sundial and wristwatch sundial kits. I organized astronomers with solar-telescopes, access to the Science Center rooftop and the Astronomy Lab's spectroscopes, a portable planetarium, and stargazing after dark. Encouraging audience participation, a Morris Dance team performed seasonal dances and erected a solstice May Pole. Since 2013, this has become an annual event.

*Prints and the Pursuit of Knowledge in Early Modern Europe*, Cambridge, MA, October-November 2011.

*Prints and the Pursuit of Knowledge*, an exhibition at the Arthur M. Sackler Art Museum, Harvard University, examined how celebrated Northern Renaissance artists contributed to the scientific investigations of the 16th century. It challenged the perception of artists as illustrators in the service of scientists. Artists' printed images served as both instruments for research and agents in the dissemination of knowledge. The exhibition, displaying prints, books, maps, and such instruments as sundials, globes, astrolabes, and armillary spheres, looked at relationships between their producers and their production, as well as among the objects themselves. My primary role in the exhibition was to make the scientific instruments accessible to the public through the design and use of replicas, gallery talks, and workshops. Activities included:

*Make Your Own 17th Century Pillar Sundial*, Cabot Science Library.
Workshop for college students and library staff to make a dial from a Pringles can.

*Charting the Heavens and Telling Time*, Sackler Art Museum.
Gallery talk for adults followed by evening stargazing using historical and printed instruments.

*Family Day / Measuring the World: Creating and Using Scientific Instruments*, Sackler Art Museum. Workshop for children to make and use two types of pocket sundials, celestial and terrestrial globes, and the human body as a measuring instrument.

*Medieval Astronomy and Use of the Astrolabe*, Cambridge, MA, March 2011.

Medieval Studies Graduate Workshop, Harvard University, in which participants made and learned to use an astrolabe.

*William James and the Psychological Laboratory*, Cambridge, MA, April 2010.

Experimental psychology instruments from the laboratory established by William James at Harvard in the 1880s were featured alongside period photographs showing them in the lab. Hands-on activities included a scale-replica of the James's waterfall illusion apparatus and color wheels; and a scavenger hunt around Harvard in search of

other surviving psychological apparatus depicted in a lab photo. The activities were organized by the Harvard Collection of Historical Scientific Instrument of the Department of History of Science in conjunction with "What Makes a Life Significant? A panel discussion in memory of William James," a program sponsored by the Division of Social Science, Harvard University.

*300 Years of Precision Timekeeping*, Cambridge, MA, October 2009.

A workshop for members of the Antiquarian Horological Society Study Tour showcasing Harvard's remarkable astronomical regulators, clocks, and watches. Participants were able to explore the clockworks and see them in operation with the guidance of the horologist and curator of the Harvard Collection of Historical Scientific Instruments.

*Environmental Servathon*, Newton, MA, November 2006.

A workshop on watershed ecology organized for 50 elementary-school-age children and led by a Senior Girl Scout with my help. Children learned about watershed conservation, pollution, and ecosystems through observations, experiments, and games. Activities included making soda-bottle ecosystems, edible aquifers, personal water meters.

*Medieval Navigational Instruments*, Kalamazoo, MI, May 2006.

"If little Lewis can do it, so can you!" Medieval scholars made their own Chaucerian astrolabes and learned how to use them. Also led hands-on activities with replica navigational instruments. Sponsored by AVISTA at the 41st International Congress on Medieval Studies.

*Transit of Venus Festival*, Cambridge, MA, June 2004.

A sunrise festival at Harvard that included observations of the Transit with modern and historical instruments, including the same telescope used by John Winthrop in 1769. There were also museum exhibitions, the Harvard Band performing John Philip Sousa's Transit of Venus March, and special lectures on history and astronomy. With 1000 people in attendance, from children to senior citizens, this was the largest Transit of Venus event in North America. Organized and sponsored by the Collection of Historical Scientific Instruments, Harvard University.

*Super Science Saturdays*, Waltham, MA, April and May, 2004

Two workshops created for the Patriots' Trail Girl Scout Council in which Junior Girl Scouts (ages 9-12) explored science through fun activities. "Science Sleuth" included crime solving with pH testing, chromatography, fingerprinting, spectroscopy, and examination of the world in ultraviolet and polarized light. "Making It Matter" included experiments with strange polymers (making slime from household materials, artificial snow) and feats of hydraulic and civil engineering (Cartesian divers in soda bottles, siphons, a geodesic club house made from newspaper, and soda-straw-and-paper-clip structures). Workshops led by Cadette Scouts (ages 12-15) with my help.

*Islamic Scientific Instruments*, Ann Arbor, MI, March 2003-2005.

Introduction to the astrolabe and pillar dial, followed by the opportunity to make one's own and learn to use them. Workshop was offered as part of an annual Islamic Science and Technology Symposium, "Earth and Sky." Sponsored by the Center for

Middle Eastern and North African Studies, University of Michigan, Ann Arbor and the Ann Arbor Public Library. Open to the public as well as the university community.

*K-12 Curricular Enrichment at the Museum*, Cambridge, MA, examples, 2001-2003.

*Time and Astronomy: Pocket Sundials*
Fourth graders from Dedham made equatorial sundials similar to those in the Collection of Historical Scientific Instruments, and enjoyed hands-on activities organized by two other Harvard museums and the Department of Molecular and Cellular Biology.

*Navigation at the Time of Columbus*
Newton fifth graders made quadrants and used replica instruments.

*Time Finding by the Stars: Nocturnals*
High school students from Boston, Texas, and Oregon built their own nocturnals.

*ARTS FIRST: Make-Your-Own Sundials*, Cambridge, MA, May 2001-2002.

In conjunction with ARTS FIRST, an annual public celebration of the arts at Harvard, children and families made two types of portable sundials similar to those in the Collection of Historical Scientific Instruments.

*On Using Early Scientific Instruments to Teach History*, Notre Dame, July 2001.

Organized for the fourth Biennial History of Astronomy Workshop, this session demonstrated creative ways to introduce real and replica astronomical instruments into history curricula and museum education. College faculty and curators made and used a nocturnal and equatorial sundial. Hands-on instruments included a replica astrolabe and cross staff.

*Lunar Eclipse Party*, Silver Spring, MD, January 20, 2000.

Organized for Montgomery County Public School children, scouts, and their families. Supplied teachers with *Shoebox Science* activities illustrating the reasons for eclipses and the nature of shadows. Offered magnificent views of the lunar eclipse, Jupiter, and Saturn with telescope and binoculars to families braving biting winds and snow.

*Total Solar Eclipse Camp-In 1999*, Washington, DC, August 1999.

Organized for the Girl Scout Council of the Nation's Capital at the National Air and Space Museum with the support of NASA. Created hands-on workshops that taught the earth-sun-moon system, time finding by the sun, and solar physics. Led 250 girl scouts (ages 10-18) in the building and use of lunariums (earth-moon models), sundials, and diffraction gratings. Delivered a planetarium lecture on the scientific and cultural history of eclipses. After camping out in the museum's galleries, scouts woke at 5:30 am to watch the total solar eclipse projected in real time onto the IMAX screen via a NASA satellite link from the Black Sea. Scouts celebrated the sun's return with fanciful costumes of yellow crepe paper and golden ribbons of their own devising.

*Discovering Time Under the Sun*, Washington, DC, summer 1999.

Five workshops created for underprivileged DC children and for adult-child pairs.

Children built and used sundials of different forms, experimented with a solar-powered car, made bracelets from ultraviolet detecting beads, and toured the exhibition, *Under the Sun*. Programs were sponsored by the Morino Institute, Smithsonian Institution Traveling Exhibition Services, and the Smithsonian Associates, 1999.

*Cooper-Hewitt Summer Design Institute: Under the Sun Teacher Workshops*, New York, July 1998.

Object-based teaching and *Shoebox Science* activities introduced teachers to ancient scientific methods and instruments, solar power, and its history. Teachers used a gnomon to find true North by sunlight, built sundials that were models of the earth, and made refracting telescopes. The telescopes were used in a 17th century manner to observe sunspots by projection. Teacher workshops were in association with the Smithsonian exhibition, *Under the Sun*.

*Solar Eclipse at Sea*, Caribbean Ocean, February 1998.

A week's worth of programs including stargazing at sea, total-solar-eclipse viewing, hands-on navigation, astronomy, history, and folklore on a solar-eclipse cruise aboard a five-masted sailing ship in the Caribbean in 1998. Three hundred participants used replica, historical scientific instruments, plus a modern sextant to discover how navigators found latitude, longitude, and time by the stars. Activities organized with Jim Lattis and sponsored by Centre Re.

## INTERACTIVE LEARNING MATERIALS

**Sundial Designs and Learning Sculptures**

Bird sundial for 40°N, an altitude dial for use as a garden or window sundial.

Playful, interactive, analemmatic sundial designed for children to find the time by their own shadows. Created for 41°N, 74°W with an echo wall and outdoor classroom in the solar alcove of the Prudential Outdoor Learning Center in the gardens of the Greater Newark Conservancy's Urban Environmental and Ecological Center at its landmark Prince Street site. Part of a project that transformed a debris-filled, brownfield, vacant lot into a park-like setting with ten thematic gardens and outdoor, environmental classrooms serving low-income youth, grades pre-K through 12, from Newark and surrounding urban areas. Newark, NJ, 2004.

"Walk through Time II," a monumental, horizontal sundial for 39°N, 77°W, using the 30-foot tall mast of a tensile pavilion as a gnomon. Shadows on the lawn indicated months and hours. Created for the Smithsonian Institution's Enid A. Haupt Garden behind the Castle on the National Mall, Washington, DC, 1999.

Analemmatic sundial for 39°N, 77°W, encircled by 12 chairs that serve as a solar powered clock. Visitor's own shadow is used to find the time. Created for the Smithsonian Institution's Enid A. Haupt Garden behind the Castle on the National Mall, Washington, DC, 1999.

"Walk through Time I," a monumental, horizontal sundial for 41°N, 74°W using the 32-foot tall mast of a tensile pavilion as a gnomon. Shadows on the lawn indicated months and hours. Installed alongside New York's Central Park in the garden of the former Andrew Carnegie mansion, now home to the Cooper-Hewitt National Design Museum, New York City, 1998.

Analemmatic sundial for 41°N, 74°W, in which the visitor's own shadow is used to find the time. Encircled by 12 chairs that serve as a solar powered clock. Created for the Cooper-Hewitt National Design Museum, New York City, 1998.

Polar sundial for 39°N, 77°W, designed as the centerpiece of the new campus of Capitol College, a technical school in Laurel, MD. Granite and brushed steel. (1998, but funding for installation reprioritized.)

Portable altitude sundials for 45°N, patterned after a Saxon sundial of the 10th century. Created for Shepherd's Watch, Montreal, retailers of wearable sundials, 1997-1998.

Pocket-sized nocturnals of pewter, brass, and silver, styled after Renaissance instruments. Used to find time by the Big Dipper. Star map on the reverse. Designed for Shepherd's Watch, Montreal, 1998.

**Activity Kits**

Astrolabe patterned after a medieval instrument by Jean Fusoris, Paris, ca. 1400, but with the stars precessed to modern positions. Constructed of cardstock and plastic for class room or informal educational use. Instruction manual includes suggestions for use in history and astronomy curriculum. Developed with James Lattis and distributed by Learning Technologies, Somerville, MA, 2006, and more recently Science First, Yulee, FL.

*Shoebox Science Kits*–Do-it-yourself scientific instrument kits that recreate early instruments, set them into historical and technical contexts, and encourage students to use them. Latitude specific as appropriate. Simple cut-and-paste designs. Developed with James Lattis, 1997-2006.

Astrolabe
Equation-of-Time Machine
Equatorial sundial
Diptych sundial
Horizontal sundial
Lunarium
Nocturnal
Pillar sundial
Quadrant
Vertical sundial

Diptych sundial kit, published in *Designing with the Sun,* a student-activity guide that accompanied *Under the Sun: An Outdoor Exhibition of Light*, a Smithsonian traveling exhibit on solar power and design, 1998-1999.