

Astro2020 White Paper: History of Astronomy

State of the Profession

Authors: Alan Hirshfeld (UMass Dartmouth), Jennifer Lynn Bartlett (U.S. Naval Observatory), David DeVorkin (National Air and Space Museum), Elizabeth Griffin (NRC Dominion Astrophysical Observatory), Jarita Holbrook (University of the Western Cape, South Africa), Terry Oswalt (Embry-Riddle Aeronautical University), Marc Rothenberg (Smithsonian Institution), Kenneth Rumstay (Valdosta State University), Sara Schechner (Harvard University), Joseph Tenn (Sonoma State University), Virginia Trimble (UC Irvine).

Contact Information: Alan Hirshfeld (UMass Dartmouth), ahirshfeld@umassd.edu

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Introduction

In his 1985 report on the scholarly effort to trace the history of American astronomy, historian Marc Rothenberg recognized that a key aspect of the field is its intellectual diversity, having formed at the confluence of three intellectual streams:

“Historians of American science, whose source lies in turn in American cultural history, are interested primarily in the social and institutional framework of astronomy. Those who approach American astronomy from the perspective of the history of astronomy are more likely to be concerned with the intellectual content of the field. Finally, astronomers have always had considerable interest in the history of their discipline, although this interest has manifested itself primarily in the form of chronologies, biographies, and anecdotes.

This diversity of interest, background, and methodology on the part of its practitioners gives the history of American astronomy intellectual breadth. Lacking shared assumptions and even agreement on what constitutes the most significant questions to be asked, these practitioners range far and wide, ever sharpening our understanding of the evolution of the American astronomical community.”

– Rothenberg, M. “History of Astronomy.” *Osiris* 1 (1985): 117-131.

A related aspect of the work done by historians of astronomy is that it includes not only the history of the subject itself but also interactions with other longitudinal sciences, such as anthropology and archaeology (as in the subdiscipline of archeoastronomy), in which different fields’ methodologies offer useful synergies. In addition, the history of astronomy is unique among the subdisciplines of American astronomy in that many of its practitioners are not professionally trained astronomers. Our reach, therefore, extends beyond the traditional astronomical community.

Role of the Historical Astronomy Division

Since 1980, the Historical Astronomy Division (HAD) of the American Astronomical Society (AAS) has been advancing interest in the historical aspects of astronomy, while also providing a forum for the presentation and discussion of scholarly research in this area. Under the rubric of “historical astronomy,” the division includes (i) the development of astronomy, from prehistoric to modern times, including theories, practices, instruments, persons, and institutions, and the role of social and cultural factors in this development; (ii) the application of historical records to modern astrophysical problems; and (iii) efforts to preserve historical astronomical structures, instruments, records, and data.

HAD meets annually at the Winter AAS meeting, devoting sessions to both oral and poster presentations on historical research conducted by its members; offering plenary lectures to the wider AAS audience by its Doggett Prize recipients and other division members; reporting on divisional affairs to the HAD membership; and carrying out divisional planning and administrative functions.

Currently, HAD has 423 active members, a significant increase from its prior six-year average membership of just over 300 members. The total includes 20 Affiliate Members (non-AAS members, such as historians of science, anthropologists, archeologists, etc.), 43 Graduate Student members, and 46 Undergraduate Student members, this last category up from just 5 such members the previous year. Of the current total membership, 119 have AAS Emeritus status (retired, although some still active in scholarly research). Most HAD members are affiliated with academic institutions, while the remainder are employed by observatories, planetariums, museums, and science organizations, or work as independent scholars. A significant number of HAD members who have retired from astrophysical research have changed their scholarly focus to the history of the field.

Despite its relatively small membership, annual HAD sessions at AAS meetings are often filled, with invited and contributed (registration-fee paying) talks and posters. The same is not the case for the corresponding history divisions of the American Physical Society (APS) and American Chemical Society (ACS) sessions at their annual or semi-annual meetings, although both total society memberships and section/division memberships are larger than AAS/HAD by an order of magnitude. [Source: V. Trimble] AAS history sessions are generally very well-attended, and attract many astronomers who are not HAD members who seek to learn more about historical aspects of their discipline.

State of the Discipline of Historical Astronomy

Research in the historical aspects of astronomy is not generally funded by either NASA or the astronomy, astrophysics, planetary sciences, etc. divisions of the NSF, although there is some funding available from divisions that cover social sciences and humanities. Many in the field subsidize their research from personal funds or small foundation grants, often paying their own travel expenses to AAS meetings and specialized conferences. For invited speakers, the AAS typically waives registration fees and provides travel support. A small fraction of HAD members supervise graduate and undergraduate students in historical research projects.

There are today a limited number of channels for peer-reviewed publication of scholarly research in the history of astronomy. The *Journal for the History of Astronomy* was founded in 1970 and is devoted to the history of astronomy from earliest times to the present, and to the use of historical records in the service of astronomy. Its subject matter extends to such allied fields as the history of the relevant branches of mathematics and physics. (5-year impact factor 0.374 for journals in the history and philosophy of science). The *Journal of Astronomical History and Heritage* was founded in 1998, and since 2007 has been published three times yearly, in March, July and November. It features review papers, research papers, short communications, IAU

reports, and book reviews (impact factor 0.36). The history of astronomy also appears in peer-reviewed general history of science journals, such as *Isis*, published quarterly by the University of Chicago Press in association with the (U.S.) History of Science Society, and the *British Journal for the History of Science*, published quarterly by Cambridge University Press in association with the British Society for the History of Science.

Mainstream astronomy and physics research journals (e.g., *Astrophysical Journal*, *Astronomical Journal*, *Science*, *Nature*) typically do not publish articles with historical themes, except in cases where historical observations provide insight into a present-day research problem. Occasional review articles on the history of astronomy appear in *Physics Today*, and in popular-level magazines, such as *Sky & Telescope* and *Astronomy*.

Among the noteworthy large-scale historical publications of the past decade is the *Biographical Encyclopedia of Astronomers (BEA)*, published in 2007 (T. A. Hockey, Editor-in-Chief). This was reissued in an expanded second edition in 2014 (T. A. Hockey, V. Trimble, T. R. Williams, K. Bracher, R. A. Jarrell, J. D. Marché, J. Palmeri, D. W. E. Green, editors). The four-volume *BEA* is unique: There is no discipline-specific counterpart in the physical or biological sciences. The *BEA* is the work of some 430 authors from forty countries, translators, and editors who produced biographies of approximately 1,850 persons, from antiquity to the modern era.

A measure of the breadth of research in our field can be gleaned from the respective specialty areas of the past winners of HAD prizes. HAD awards the LeRoy E. Doggett Prize biennially to an individual who has significantly influenced the field of the history of astronomy by a career-long effort. Recipients of the Doggett Prize over the past decade are:

2018: Sara J. Schechner, Harvard U. (early scientific instruments, history of American astronomy, comets).

2016: Albert van Helden, Rice U. (history of the telescope and telescopic studies).

2014 F. Richard Stephenson, Durham U. (applied historical astronomy).

2012: Woodruff T. Sullivan, III, U. of Washington (history of radio astronomy).

2010: Michael J. Crowe, Notre Dame U. (William and John Herschel, history of the extraterrestrial life debate).

HAD also awards the Donald E. Osterbrock Book Prize biennially to the author(s) of a book judged to advance the field of the history of astronomy or to bring history of astronomy to light. Recipients of the Osterbrock Book Prize over the past decade are:

2019: Stella Cottam and Wayne Orchiston for *Eclipses, Transits, and Comets of the Nineteenth Century: How America's Perception of the Skies Changed*.

2017: Thomas Hockey for the *Biographical Encyclopedia of Astronomers* (2nd edition).

2015: Barbara J. Becker for *Unravelling Starlight: William and Margaret Huggins and the Rise of the New Astronomy*.

2013: Harvey M. Bricker and Victoria R. Bricker for *Astronomy in the Maya Codices*.

2011: Nathan Sivin for *Granting the Seasons: The Chinese Astronomical Reform of 1280, With a Study of Its Many Dimensions and a Translation of its Records*.

A sense of the breadth of scholarly interests among astronomy historians is further conveyed by the topics addressed in single-theme Special Sessions at the annual HAD meetings, including:

- Preservation of astronomical facilities and archival data.
- Historical development of various subfields of astronomy, e.g. solar, planetary, stellar, etc.
- Formative years of observational astronomy in various wavelength domains, e.g. radio, x-ray, infrared, etc.
- Observational and theoretical roots of the Big Bang model of the universe.
- Application of historical astronomical records to the investigation of problems in modern astronomy and geophysics.
- History of observations of transits of Venus.
- Impact of the Great War on astronomy and other sciences.
- History of scientific and societal ideas about extraterrestrial life.

The Coming Decade

Going forward, there are a number of significant anniversaries in the development of astronomy that will stimulate further historical investigations: centennial of the 1919 solar eclipse expeditions and their impact on the affirmation of general relativity; centennial of the Shapley-Curtis debate on the scale of the universe; centennial of the founding of the International Astronomical Union; and sesquicentennial of the development of the periodic table of the elements.

Looking ahead to the 2020s, we anticipate research opportunities associated with “big data,” such as increased on-line availability of many more journals, observatory records, scanned archives, and other historical documents. Such retrieved information will enable serious statistical studies of what sorts of science, done by what sorts of individuals and collaborations, with what sorts of facilities have contributed most to mainstream astronomy and astrophysics in the recent past; but also, over longer time scales, how ideas and techniques, once resisted, gradually permeate or suddenly break through to become mainstream science.

In the same vein, we acknowledge increased capability and interest in Time-Domain Astronomy (TDA), which focuses on variability in a wide array of celestial objects, not only known variables such as novae, supernovae, gamma-ray bursts, active galactic nuclei, binary stars, pulsars, and the like, but also in many objects thought to be non-variable. Of growing interest are transient changes, typically outbursts that occur over brief cosmic timescales, from decades down to milliseconds. Only by capturing these intermittent electromagnetic signatures can astronomers begin to appreciate the energy and activity that is clearly nascent in the producers of such events, and to modify theories (particularly the initial parameters) when modeling the evolution of these kinds of celestial objects.

TDA has demonstrated its ubiquitous nature in efforts like the Sloan Digital Sky Survey (SDSS), Digital Access to a Sky Century @ Harvard (DASCH), and Gaia project, and is now driving new ones like the Large Synoptic Survey Telescope (LSST), Transiting Exoplanet Survey Satellite (TESS), Canadian Hydrogen Intensity Mapping Experiment (CHIME), and Large Sky Area Multi-Object Fibre Spectroscopic Telescope (LAMOST). The breadth and scope of variability in the cosmos cannot begin to be appreciated unless historical observational data, some going back over a century (to the introduction of photography into astronomy), are made available in modern electronic formats and can thus be included in analyses of modern data. Researchers can then assemble truly comprehensive pictures of the physical behavior of such objects over time.

Yet to be examined are a multitude of photographic, photometric, and other astronomical databases in archives around the world. Thus the preservation, digitization, and accessibility of these archives are of critical importance to present-day astronomy, for they determine the extent of time over which signs of variable and transient events can be identified. Attendees of TDA-themed meetings clamor for more older data to be captured digitally and released to the public; HAD will assess progress in this area and issue recommendations for its advancement. Preservation of observational data goes hand in hand with preservation of observational artifacts and the observatory archives that house them, an effort described below.

Another area of historical research that will be continued and expanded in the coming decade is the role of women and minorities in the history of astronomy. Also, the historical roots of relatively new observational technologies, such as gravitational wave astronomy, neutrino astronomy, and exoplanet astronomy need to be documented and interpreted. Upcoming astronomy-related space missions, such as the James Webb Space Telescope, Wide Field InfraRed Survey Telescope (WFIRST), and the Mars 2020 probe, likewise have historical roots that should be documented.

The 2020s also provide the opportunity to update and expand a number of important resources for scholars in the field. These include the aforementioned *Biographical Encyclopedia of Astronomers (BEA)*, currently in its second edition (2014), as well as bibliographical guides to the historical literature. The latter are exemplified by two classic works from 1982: D. H. DeVorkin, ed., *The History of Modern Astronomy and Astrophysics: A Selected, Annotated Bibliography*; and M. Rothenberg, ed., *The History of Science and Technology in the United States: A Critical and Selective Bibliography* (New York: Garland, 1982).

The following ongoing projects will continue into the 2020s:

Working Group on the Preservation of Astronomical Heritage (WGPAH)

Established by HAD in 2007, the Working Group on the Preservation of Astronomical Heritage (WGPAH) is charged with developing and disseminating procedures, criteria and priorities for identifying, designating, and preserving astronomical structures, instruments, and records so that they will continue to be available for astronomical and historical research, for the teaching of astronomy, and for outreach to the general public. HAD will continue to support the work of WGPAH through thematic sessions at meetings and in other ways. For further information, see WGPAH's separate State of the Profession white paper.

HAD Oral History Project

The Oral History Project, led by HAD and modeled on the long-running program initiated by the American Institute of Physics (AIP) Niels Bohr Library, as well as on National Public Radio's "StoryCorps," conducts in-depth interviews with astronomers to create a permanent record of personal recollections and reflections on the development of the field over the past few decades. Since the project's inception in 2013, over 150 scientists, technicians, family members, and STEM support staff have been interviewed. In addition to the project's founder Jarita Holbrook, the core interview team consists of Jennifer Bartlett, Jim Lattis, and Sanlyn Buxner, with Sharon Traweck, Dan Pendick, Eric Barron, and Teresa Wilson as additional interviewers.

Whereas the AIP's Oral History interviews often lasted six or more hours spread over more than one day, the AAS project's interviews are between 1.5 to 2 hours, as they are meant to capture relevant aspects of the interviewee's life, and not necessarily their entire life. The interviews begin with gathering background information, noting career moves, highlighting mentors, but also touching on current issues relevant to our community, such as diversity, sexual harassment, data science, queue observing, tenure, and getting individual recognition for collaborative research.

Interviews are conducted at the AAS January meetings and at some of the other AAS-sponsored meetings, including the Division of Planetary Science (DPS) and the High Energy Astrophysics Division (HEAD). A quiet room is reserved at the conference venue, where the interviews are conducted using high-quality voice recorders. Training workshops for conducting the interviews, necessary to build the team of interviewers, have been held regularly at the AAS January meetings. Training includes how to use the equipment and how to balance having a relaxed conversation with gathering information of interest to future generations. To facilitate this, interviewers are encouraged to memorize the list of open-ended questions, take notes only if absolutely necessary, and follow the flow of conversation with minimal interruptions.

The AAS Oral History Project is unique in that anyone who volunteers to be interviewed is included, schedule permitting: It is not necessary to be "old and famous." The interviews include people from all career stages from undergraduates to emerita. By design, the goal is to capture the lived experiences of people currently engaging with the AAS community, which means it

must be open and inclusive. Requests for interviews are announced via AAS emailers, the HAD newsletter and conference booth, and targeted emails to departments of the universities where the AAS meeting is taking place.

Interviews are digitally recorded, then transcribed in partnership with AIP or using one of the services contracted by AAS; the resulting transcript is reviewed by both the interviewer and the person interviewed. The final transcript is given to AIP to be placed in their oral history archive at <https://www.aip.org/history-programs/niels-bohr-library/oral-histories>. The people interviewed have the option to release their interview to the public immediately or after some period of time (e.g., 10 years). Finally, some people have needed more than one interview to capture everything that they want to say.

AstroGen

Since 2013 HAD has sponsored the Astronomy Genealogy Project, directed by Joseph S. Tenn. “AstroGen” is a database of astronomy-related doctoral dissertations. Similar to the highly successful Mathematics Genealogy Project, which has been in operation since 1996, AstroGen contains information about and links to the authors, their thesis advisors (a.k.a. supervisors), the degree-granting universities, and their theses. As of June 2019, there are about 28,000 theses in the database, with nearly complete coverage of 24 countries. AstroGen will enable researchers to compile academic genealogies in which a scholar's parent is his or her thesis advisor. The AAS has agreed to host AstroGen on its website, and work is underway to make this happen.

For further information, see the AstroGen website: <https://astrogen.aas.org/>.