Amateur Astronomers and the Hubble Space Telescope

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Astronomy is unique among the sciences with regards to the large, widespread, and competent community of amateur scientists that has always played a significant role in advancing the field. Amateur astronomers still frequently make contributions to astronomical research, because some types of observations are ideally suited to the capabilities of amateur astronomers, and impractical for the oversubscribed telescopes at major observatories. Amateur astronomers are also an important link between front-line astronomical research and the general public, including science teachers, students, and the taxpayers who fund the research.

Since the very beginning of the Hubble Space Telescope (HST) project, NASA and Congress were interested in finding ways for amateur astronomers to participate in HST research. The director of the Space Telescope Science Institute (STScI), Riccardo Giacconi, decided to allocate some of his "Director's Discretionary" time to amateur observing programs. In December 1985, the leaders of seven national amateur astronomy organizations met at STScI in Baltimore to discuss the participation of amateur astronomers in the HST project:

- Janet Mattei, American Association of Variable Star Observers (AAVSO)
- John Westfall, Association of Lunar and Planetary Observers (ALPO)
- George Ellis, Astronomical League
- Jesse Eichenlaub, Independent Space Research Group
- Gerald Persha, International Amateur-Pro Photoelectric Photometry (IAPPP)
- David Dunham, International Occultaion Timing Association (IOTA)
- Stephen Edberg, Western Amateur Astronomers

This group became the Amateur Astronomers Working Group (AAWG), which solicited all HST amateur proposals and performed their preliminary reviews. In all, there were 13 approved amateur HST programs (see below).

On August 7, 1986, Riccardo Giacconi announced the new HST amateur observing program at the Astronomical League's annual convention. The following are excerpts from his announcement....

> "Observing time on Space Telescope will be at a premium. An offer of HST observing time to amateur astronomers, therefore, is not lightly made. Yet I am making this offer to you today. I expect that amateur astronomers will use HST to ask refreshingly new questions and that your findings will, as they always have, make a real contribution to the advancement of astronomy."
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> "Amateur and professional astronomers share a great commonality of interests. We aid each other. In the past, the progress of astronomy was largely the work of amateurs. Rather than

> emphasize the differences between professional and amateurs in a field such as astronomy where the distinction is so thin, let us emphasize instead our common thirst for knowledge, our love of nature, and our appreciation of the beauty and mystery of the universe. And let us join efforts to share these feelings with people everywhere."
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> "The dazzling discoveries by scientists remain curiously sterile unless they become assimilated in the general culture and become part of the intellectual heritage of mankind. Amateur astronomers have always been instrumental in providing that link and their impact on general education has been enormous. Particularly today when new astronomical knowledge is accumulating at such a rapid rate, the connection between forefront research and education should be stronger than ever."

The "formal" HST amateur program is ending. The final HST amateur program will execute in August 1997. Reductions in funding and staff at STScI have made it increasingly difficult to support amateur program development and data analysis.

However, many more amateur astronomers have also been involved in HST research in an informal and indirect manner by conducting coordinated ground-based observations for HST users. For example, amateurs have monitored targets such as variable stars -- either as part of ongoing efforts (by AAVSO) or in some cases as part of special observing campaigns for specific HST programs. Coordinated amateur observing campaigns have triggered HST target-of-opportunity observations of novae and comets, and provided important multimode data for objects being observed by HST.

This type of collaboration between amateur astronomers and HST users could expand for the benefit of both with a relatively small amount of facilitation. Even if only a few HST programs each year are suitable for amateur collaboration, past experience shows that this is enough to engage a large number of amateur astronomers.

It is hoped that relatively passive facilitation could lead to more and currently unimagined forms of amateur-professional collaboration in the future, and maintain the important link between amateur and professional astronomers in the HST mission.

Hubble Space Telescope observing programs by amateur astronomers

The amateur Hubble Space Telescope (HST) observing programs listed below are now all completed -- the last program executed in August 1997. Using the ID numbers included below, you can view abstracts and datasets for these programs.

Round 1:

- "SO2 concentration and brightening following eclipses of Io",
  Jim Secosky (science teacher, NY), WFPC1 program 2798 in April-June 1992, Icarus 111
- "Oort Cloud comet UV emission in Nova Cygni 1992",
  John Hewitt (educator, CA), WFPC1 programs 2797 and 4208 on 13 August 1992
- "Detection of protoplanets through super-resolution of T Tauri stars",
  Ana Larson (accountant/teacher --> now PhD!, WA), WFPC1 program 2799 (cancelled due to spherical aberration problem)

- "Magnetic fields of peculiar A-type variable stars",
  Pete Kandefer (electrical engineer, CT), GHRS program 2800 on 1 June 1992

- "Imaging the arc in the galaxy cluster 2244-02",
  Ray Sterner (computer scientist, MD), WFPC1 program 2801 on 25 April 1992

Round 2:

- "A galaxy-quasar association displaying an anomalous redshift",
  Karl Hricko (science teacher, NJ), WFPC1 program 4750

- "Transition comets -- UV search for OH emission in asteroids",
  Harald Schenk (civil engineer, WI) and Jim Secosky (teacher, NY), FOS program 4784

  Sky & Telescope photo of Secosky and Schenk planning observations with Max Mutchler at STScI, 1993

- "Dynamics of binary asteroids",
  Ben Weiss (college student, MA), WFPC1 program 4764, Icarus 137

- "UV emission spectrum of the Lagoon Nebula (M8) an HII region",
  Nancy Cox (nurse, CA), GHRS program 4805

- "Titan's atmosphere and evolution",
  George Lewycky, (computer programmer, NJ), GHRS program 4790

Round 3:

- "Lyman-alpha spectra of discordant redshift system PKS-1327-206",
  Dennis Tye (computer programmer, CA), FOS program 5654 in January 1996

- "The deuterium/hydrogen ratio of the local interstellar medium",
  Bill Alexander (chemist, WV), GHRS program 5650, August 1994 to March 1995, ApJ 470

Round 4:

- "Morphology of the active nucleus and radial filaments of NGC 1808",
  Jim Flood (chemist, NJ), WFPC2 program 6872 on 14 August 1997

Amateurs in the Early American Astronomical Society

by Brant L. Sponberg

At the time of the Society's formation, as Richard Berendzen has pointed out, James E. Keeler wanted the Society to be reserved for "those who are capable of accomplishing something in astronomy" and felt that there was no need for "another popular society on the lines of the A.S.P. [the Astronomical Society of the Pacific] or the British Ast[ronomical] Association" (Keeler to Hale, 10 Jan. 1899, noted in Berendzen, 37). Keeler's wishes for a high professional standard of membership in the Society at the expense of the possible "popular" or amateur membership, however, were not heeded by the Executive Council of the nascent Society. Article II, Section 1 of the Society's Constitution came to read, "Any person deemed capable of preparing an acceptable paper upon some subject of astronomy, astrophysics or related branch of physics, may be elected by the Council to membership in the Society upon nomination by two or more members of the

Society." In a paper read at the fiftieth anniversary of the AAS, Joel Stebbins recollected:

The qualification that a candidate for membership be deemed capable of preparing an acceptable paper has been rather liberally interpreted. The council once received a letter from an applicant stating that he was not a lawyer for nothing; and he pointed out that the rule does not state acceptable to whom. He himself could prepare a paper which would be quite acceptable to the janitor for starting a fire. I believe that the Council ruled that the candidate's own letter could be construed as an acceptable paper. In other cases, it has been suggested that a good-sized check on a bank might be considered an acceptable paper on astronomy (Stebbins, 405).

Stebbins' reminisce speaks to the question of what constituted an acceptable astronomical paper in the first years of the Society. Liberal interpretation aside, however, there were other reasons for keeping the requirements for membership loose during the first years of the Society's existence. This policy reinforced the impression that the founding purpose of the AAS was as a society dedicated to the advancement of astronomy as a science, not necessarily as a profession. And as Marc Rothenberg has shown in "Organization and Control: Professional and Amateurs in American Astronomy, 1899-1918," this policy sought to bring together everyone capable of contributing to the science under the same roof not only to advance the science and to swell the still small membership roster, but to establish some form of control over what research was done and how it was done. Amateurs constituted a potentially valuable workforce, but it was one that required professional oversight (Rothenberg, 1981). We follow Rothenberg's arguments in this essay.

The Society's membership policy had to meet, however, with the reality of the diverging interests of the professional and amateur astronomer as the Nineteenth Century gave way to the Twentieth and concerns about professionalism became paramount. Eventually, the leadership of the AAS realized that the best means of bringing professionals and amateurs together was to direct amateurs to participate in professionally controlled organizations that sought out useful things to do. Thus although the AAS sought out individual amateur members and tried to encourage and educate them, the major means by which the AAS kept its amateur members from leaving and forming independent societies was to make the amateurs feel they were part of the professional enterprise.

In the Nineteenth Century, amateurs could well compete with professionals in some areas because neither training, nor professionalism, nor telescope power were critical obstacles. These conditions changed, however, as research boundaries became better defined, larger telescopes pushed the horizons back and professionalism took hold. The type of amateur astronomer who wished to participate in research was relegated to the subjects that are, in large part, still their domain today: asteroid and comet searches, meteor watches and variable star observation.

Although the professional astronomer may have given little thought to the research of amateurs in his field, the general public did not distinguish the work of an amateur who had the wherewithal to dabble in observation or speculation from the work of a professional working at a research observatory. This was because:

...the old definition [of science] in the United States resulted in a great readiness to regard almost anything as "science" that worked or was even merely favorably regarded. The general public and the great institutions of the society had this tendency. Relatively few laymen consciously placed abstruse scientific work in a ranking above, for example, the skillful labors of talented tinkerers (Reingold and Reingold, 2).

It was perhaps this American sympathy for the maverick tinkerer and amateur savant at the turn of the century that drove Frederick C. Leonard, a teenage amateur astronomer in Chicago, to found the Society for Practical Astronomy (S.P.A.) in 1909. Leonard's organization floundered for two years, but Leonard began to aggressively recruit new members via announcements in Popular Astronomy (Leonard, "The Society for Practical Astronomy," 455-56). Leonard's relations with the professional AAS, as recounted by Rothenberg, therefore mark an interesting case study of the boundaries of professionalism and how they were tested in the early years of the society.

Although Popular Astronomy was targeted at amateur astronomers, it was written and edited by professional astronomers. When Leonard submitted his advertisement to Popular Astronomy, Herbert Wilson, Director of Goodsell Observatory and the editor of the journal, placed commentary beneath Leonard's announcement suggesting that amateurs, instead of forming their own general organizations, should divide themselves into specialized sections that could take up research topics that were important, but had been neglected by professionals and were still within the range of amateur instruments and proficiency (Wilson, 313-314). Wilson wanted amateur astronomers to specialize specialize in these areas, subordinating

their research to the needs and direction of professionals.

Leonard's S.P.A. experienced a burst of growth after the announcement was published in Popular Astronomy (55 members at the end of 1911, 80 by 1912). Leonard followed Wilson's plan, and his new membership was divided into nine problem-oriented sections (Leonard, "An Appeal to Amateur Astronomers," 318). Unfortunately, despite Leonard's industry, the S.P.A. could not compete with other emerging amateur societies that benefited directly from the supervision of professional astronomers. Leonard's society particularly suffered from a dearth of dedicated, well-equipped and serious amateur astronomers who preferred the direction of professional research programs. The Monthly Register for Practical Astronomy, the S.P.A.'s journal, lacked systemic observations in its reports and papers, and members began to neglect their dues as early as 1916. The Register began appearing with increasing irregularity, and on 1 July 1918, S.P.A. meetings were declared suspended due to the War. The S.P.A. never recovered.

In the meantime, the AAS (still the A.&A.S.A.), rejected Leonard in 1911 when, at the age of 21, he filed his application for membership. Leonard was told that he was incapable of producing an acceptable paper on an astronomical subject, the only criterion for membership in the Society, despite his many descriptive articles in Popular Astronomy, the Monthly Register for Practical Astronomy, and English Mechanic. Unofficially, the Society's Executive Council decided that Leonard was too young, even though there was no minimum age requirement for membership in the Constitution or Bylaws. He was told that he would be elected when he was 22 (Leonard to Schlesinger, 11 Sept. 1911 and Schlesinger to Leonard, 13 Sept. 1911). This too proved to be a false pledge, and Leonard did not gain membership in the Society until 1923, after he was granted a Ph.D. and was a member of the faculty of the University of California at Los Angeles.

Although there is evidence that Leonard's rejection was due to his efforts to establish an independent society: the Society's leaders were definitely concerned about the question of proper professional behavior. For example, when amateur astronomer Arthur Kinsman wrote to his old school friend, George Ellery Hale, for aid in joining the Society, Hale told Joel Stebbins, Secretary of the Society, that "he is safe enough...I don't believe he would use his membership for commercial or advertising purposes." Although membership requirements were officially loose, the AAS leadership necessarily scrutinized the aims of those wishing to join against the ideals of the Society, and from his actions, Leonard seemed to be too much of a maverick (Kinsman to Hale, undated).

Indeed, there was no place for maverick amateurs. Those amateur societies formed by professionals consisted mainly of enthusiastic and compliant workers. For example, Edward C. Pickering, Director of the Harvard College Observatory, formed an amateur astronomical society that was directly beneficial to his research program at the Harvard Observatory. In the issue of Popular Astronomy following the one containing Leonard's announcement of the formation of the S.P.A. and Wilson's suggestions about the organization of amateur astronomical societies, Pickering, who was also President of the Society, described how his observatory had utilized amateurs on a small scale to generate data on variable stars (Pickering, 314). This research was closely managed with star charts and instructions, and all data reduction and analysis were handled by Harvard Observatory staff. Pickering was hardly a new hand at finding inexpensive means of generating enormous mountains of data; he had hired women, who worked for less than their male counterparts, as research assistants in his vast data gathering programs. Pickering stated that the Harvard College Observatory would appreciate the cooperation of any amateur interested in such research. His leading amateur colleague, William Tyler Olcott, agreed to lead a section of variable star observers within an amateur society created along the lines of Wilson's proposals. This suggestion led to the establishment of the American Association of Variable Star Observers, the A.A.V.S.O., at the end of 1911 (Olcott, 655-56).

Unlike Leonard, Olcott was the professional astronomer's ideal amateur. He was "willing to put up with the regimentation, systemization and discipline [of the field] in exchange for the opportunity of contributing to astronomy" (Stebbins, 36-37). Olcott's profession was law, and through its ritual and hierarchy, he was capable of flourishing under the command of professional astronomers like Pickering.

Another amateur society was also formed as a result of Wilson's call. Charles P. Olivier, who had just received his Ph.D. with a dissertation on meteor orbits, proposed to supervise another section of Wilson's amateur astronomical society devoted to the observation of meteors. Thus the American Meteor Society, the A.M.S., was born (Olivier, "An Appeal," 126-8 and "A Meteor Section," 586).

In time, both the A.M.S. and the A.A.V.S.O., headed by professionals, drew away the best of a limited number of

experienced amateur observers from purely amateur organizations like the S.P.A. Professional astronomers as well reaped the benefit of these focussed and organized groups, because they soon started to yield up valuable observational data. Accordingly, the Society's Meteor Committee and Committee on Variable Stars both extolled the efforts of these amateurs in their reports.

As Lankford (1981, 276-277) and others have argued, it is difficult to neatly categorize amateurs and professionals in late nineteenth-century science. But, he adds, it is useful to be able to distinguish them to some degree. A varying level of commitment to amateur and professional practice certainly do distinguish people like Leonard, Olcott, Wilson, Pickering and Keeler. Reingold (1976) has examined the characteristics of professionalism among the ranks; one of his categories, that of "cultivator," fits well the ideal, dedicated amateur whose knowledge of a particular science went beyond the "vernacular" into the "learned" culture of the discipline: that of the "practitioner." Olcott would certainly fall here as a dedicated programmatic observer. Lankford cautions us, quoting Stephen Brush (1979, 58-59), that the broader aspects of Reingold's categories are important so as to be able to distinguish "amateurs like Lewis M. Rutherfurd and Percival Lowell, who became researchers able to compete with the professionals on more than equal terms" from "those who remained cultivators, [Olcott, we argue] discovering an occasional comet or reporting on variable stars." What Brush does not emphasize, however, is the degree to which much of normative astronomy at the turn of the century was just the type of activity engaged in by the cultivator. Further, Rutherfurd and Lowell were really patrons of astronomy in the English mode of wealthy activist, establishing observatories that employed professionals. Nevertheless, partly from their personalities but mainly from the types of research they directed, one (Rutherfurd) became a revered legend and the other (Lowell) an annoyance. Even though, as Lankford points out (1981), they and others like them were critical agents in early astrophysical practice, it appears that amateurs who did not conform to minimum standards of practice, whether they be Lowells or Leonards, were shunned.

How did the differing view of what level of professionalization was appropriate for membership in the AAS influence Society membership itself? Marc Rothenberg has examined the statistics of amateurs in the early AAS, and has noted that the Society of 1899 started out with 15 percent amateur membership. Since a "trickle of new amateur members" continued after 1899, "professional status was not a prerequisite for membership" he concludes, but even so, he feels that the "status of amateurs in the Society prior to 1909 was marginal." Following his conclusions, only one percent of the papers presented each year were authored by amateur members, and amateur membership declined from 1899 onwards to a low of 12 percent in 1909 (Rothenberg, 311). Perhaps most important was the fact that the membership nomination form included a line asking applicants to list their "Professional Position" (AAS "Nomination for Membership," Hale Microfilm). Rothenberg notes that it was impossible to hide one's amateur or professional status in the early Society.

Other factors, however, were at play that increased amateur involvement in the Society during its early years. In January 1909, secretary of the Society William J. Hussey, alarmed by the dominance of Harvard College, University of Chicago and University of California observatory staffs in the Society and by a decrease in incoming membership applications, asked for suggestions on how to increase membership in the Society. E. D. Roe of Syracuse University answered Hussey's call by suggesting they increase amateur membership in the Society (Rothenberg, 1981, 312). Roe wanted amateurs to "be taken under the protective wing of the society and inspired to do useful work for the sciences" (Roe to Hussey, 29 Jan. 1909, quoted in Rothenberg, 1981, 312). Roe's pleas were realized by Pickering and Olcott in the A.A.V.S.O., and by 1918, most of the committee members on the Society's Committee on Variable Star Observations were also amateur members of the A.A.V.S.O.

Realizing the usefulness of amateur astronomers, the Society debated if it should adopt new classes of membership to include more amateurs. At issue was the creation of an associate membership for amateur astronomers, a class of membership that would have denied voting and office holding rights but otherwise was accorded full rights of membership (including the right to deliver papers) to any individual interested in astronomy. A "Committee on Associate Members" was appointed with Frank Schlesinger as Chair and Olcott as one of its members (Schlesinger to Members of the Committee on Associate Members, 22 Nov. 1916). Members of the committee expressed doubt that associate members would be capable of delivering adequate papers; if they reserved the right to do so and actually wrote adequate papers, they could become regular members anyway. Pickering opposed such a stratified membership, noting that the Royal Astronomical Society had low membership requirements but adequately screened out bad papers and that the AAS had already rejected some amateur papers. Pickering also suggested relaxing all membership requirements to include all those interested in astronomy, rather than only those deemed capable of producing an acceptable astronomical paper (Pickering to Schlesinger, 20 Dec. 1916). Schlesinger's committee never came to a consensus regarding the terms of an associate

membership and in the face of Pickering's opposition, decided that there was "no reason for trying to have two classes of members" (Minutes of the Executive Council, AAS, 30 Aug. 1917). Although Schlesinger's proposal was well intentioned in trying to expand amateur membership, the Society realized that it might offend some amateur members, perhaps to the detriment of professional research interests.

By the end of its second decade of life, the AAS had gained some degree of control over amateur astronomy by reconciling one of its founding principles, the inclusion of both amateur and professional astronomers, with the professional research goals of its members by managing amateur resources and bringing them constructively to bear in professional research programs.

[Note: Much of the discussion in this essay is distilled from arguments made by Rothenberg, 1981, cited in the bibliography.]