Edward C. Pickering: The Seventh Bruce Medalist

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Edward Charles Pickering
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1908 Bruce Medalist

(Photograph c. 1895, courtesy of the Mary Lea Shane Archives of Lick Observatory, University of California, Santa Cruz)

In 1875 the directorship of the Harvard College Observatory was offered to Simon Newcomb, the man widely considered to be the United States' leading astronomer. Newcomb declined the offer; one reason, he wrote in his autobiography years later, was that the Observatory was "poor in means, meagre in instrumental outfit, and wanting in working assistants; I think the latter did not number more than three or four, with perhaps a few other temporary employees. There seemed little prospect of doing much."[1]

The following year Harvard president Charles Eliot surprised many astronomers by awarding the position to a 30-year-old physics professor at the young Massachusetts Institute of Technology. Edward Charles Pickering, whose education ended when he received his bachelor's degree from Harvard's Lawrence Scientific School on his nineteenth birthday, had already achieved acclaim for founding the first instructional laboratory and publishing the first laboratory manuals in the United States.

Upon taking over the observeratory 1 Feb 1877, Pickering decided that photometry, the measurement of the brightness of celestial objects, was the least crowded field in American astronomy. Working with local opticians Alvan Clark and Sons, he invented a series of new photometers for visually comparing the brightnesses of two stars. He assigned each star a relative brightness level, using the magnitude system of Oxford University's Norman Pogson, by which a difference of one magnitude corresponded to a ratio of brightness of 2.512, the system in use today.[2] He also decided on Polaris, a star that is always visible and always at about the same altitude, as his reference standard. This was not so wise a choice, as it was discovered some years later that the North Star's brightness varies by 14% over a period of four days.

Apparently Pickering enjoyed making visual photometric measurements; he made more than one million of them. His first visual study, the 1884 *Harvard Photometry*, gave magnitudes of 4260 stars brighter than sixth magnitude. Its successor, published in 1908, went down to seventh magnitude and gave magnitudes of more than 45,000 stars. It was the standard until replaced by photographic surveys, which in turn were later surpassed in precision by photo*electric* measurements.

Pickering was always eager to make use of the relatively new astrophysical techniques, including photography and spectroscopy as well as photometry. Astrometry, the "old" astronomy of measuring star positions, was less interesting to him. He believed that the time was not yet ripe for theorizing. The steady accumula-

1. Newcomb, Simon, *Reminiscences of an Astronomer* (Houghton Mifflin, Boston and New York, 1903), p. 212.

2. This way a difference of five magnitudes corresponds to a brightness ratio of exactly 100, *i.e.*, a first magnitude star is 2.512 times as bright as a second magnitude star, 2.512^2 times as bright as a third magnitude star, and $2.512^5 = 100$ times as bright as a sixth magnitude star. Astronomical magnitude systems typically assign a *larger* positive number to a *dimmer* object (thus a magnitude 6 star is dimmer than a magnitude 2 star.)

tion of "astronomical facts" was his goal, and, as he expected, later generations of astronomers have been grateful.

In the 1880s he began the regular photography of the skies which led to that phenomenal resource, the Harvard photographic plate collection, with which astronomers of recent years have studied topics such as the variability of quasars and a star that is possibly a companion to a black hole.

Pickering urged a quickly-made photographic chart of the entire sky. He was disappointed when the International Astrographic Congress in Paris in 1887 adopted a plan whereby the world's observatories would build identical long-focus telescopes with small fields of view, and then spend years cooperatively making such a chart. When little progress was made (the maps were never completed), Pickering went ahead on his own, using wide-field cameras, and published the first photographic chart of the entire heavens in 1903.

A member of an influential Boston family, Pickering was adept at raising funds from the wealthy. This was fortunate, as the university provided no financial support, and government support of research was still in the future. (In the early years the observatory, like most of that era, earned some income by "selling time," providing accurate time signals via telegraph to those, such as railroads, who would pay for them.) In his first year Pickering persuaded seventy-one individuals to pledge annual gifts totalling $5000 per year for five years.

In 1882 New York medical professor and amateur astronomer Henry Draper died suddenly at age 45, just ten years after taking the first photograph to show absorption lines in the spectrum of a star and shortly after deciding to devote all of his considerable energies and fortune to astronomy. Pickering offered much assistance as the widow, Anna Palmer Draper, struggled to carry on the astronomical research in which she had been a partner. When it became apparent that she could neither operate the private observatory alone nor find suitable assistants, Pickering gently suggested that she might wish to collaborate with Harvard. In 1886 she agreed to provide the means for Harvard to produce a photographic study of stellar spectra as a memorial to Henry Draper. The project grew considerably over the remaining twenty-eight years of her life and continued long afterward. She gave the Observatory the Drapers' 11-inch refractor and excellent 28-inch home-made reflector, and what eventually amounted to over $387,000 (most of it inherited from her father). This was at a time when an assistant could be hired for $500 a year.

The *Draper Catalogue of Stellar Spectra*, published in 1890, listed the magnitudes and spectral classes of 10,351 northern stars. Featuring a new system of spectral classification, with classes A through N (omitting J), it was primarily the work of Mrs. Williamina Fleming, the first of a number of talented women Pickering brought into the observatory to work by day with the photographic plates which the men exposed at night.

Meanwhile Pickering hired Antonia Maury, a Vassar graduate and niece of Henry Draper, to make a detailed study of the spectra of 681 brighter northern stars. This project took longer, but it yielded rich dividends. Maury invented her own classification system, based in part on differences in spectral line width among stars of the same spectral type. These differences were greatly appreciated by the young Danish astronomer, Ejnar Hertzsprung, who used them to distinguish between huge, low density *giant* stars and smaller, high density *dwarf* stars (also called main sequence stars), and to develop the Hertzsprung-Russell diagram.

Over Hertzsprung's objections, this difference was dropped in the next, and most long-lasting, spectral classification system. Introduced by Annie Cannon, a Wellesley graduate who joined the Harvard staff in 1896, it deleted some of Fleming's classes and rearranged the remaining sequence in the order OBAFGKM, later found to correspond to decreasing surface temperatures of stars. Subdivisions were given numbers; for example, G2 (the Sun's class) means two-tenths of the way from G to K. Now usually called the Harvard sequence, it was adopted by the world's astronomers in 1913.

While Fleming turned to the spectra of peculiar stars, Cannon classified the spectra of more than 225,300 stars for the Henry Draper Catalogue (and about 170,000 more for its extensions, produced after Pickering's time). Both northern and southern stars were included, since in 1887 Pickering had managed to gain control of the $230,000 Boyden Fund, left eight years earlier for the establishment of an astronomical observatory on a mountain peak. After the failure of a short-lived observatory on Mt. Wilson in California, he used the funds to erect a highly successful one at Arequipa, Peru, from which his observers, most notably Solon I. Bailey, sent back plates for the Harvard women to classify. Tiny spectra of many stars were obtained on each plate by placing a prism in front of the telescope's lens.

The southern observatory resulted in perhaps the most important discovery of the Pickering years. So many plates were obtained that Henrietta Leavitt was able to discover and determine the periods of a great many variable stars in the Large and Small Magellanic Clouds. In 1908 she published a list of 1777 such stars, pointing out that the brighter variables of the type known as Cepheids had longer periods. In 1912 she presented a graph of period vs. apparent magnitude for 25 variables which allowed relative distances to be calculated for Cepheids anywhere they could be found. This led directly to the first determinations of distances to globular clusters (by Harlow Shapley) and to neighboring galaxies (by Hertzsprung and, with more effect, by Edwin Hubble)

In 1887 the Harvard College Observatory acquired the income from another large bequest, the Paine Fund. Pickering also donated more than his salary, usually anonymously, to the growing research programs of the observatory, but this was still not enough for all of his projects. He

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advertised for a donor to provide $50,000 to be used for "A Large Photographic Telescope," with which to make large field photographs of the entire sky. His circular attracted the attention of a reclusive New York heiress, Catherine Wolfe Bruce, whose gift for the Bruce telescope was the first of a long list of contributions to astronomy, nearly all of them made with the advice of Pickering. It was he who helped her draw up the statutes for the award of the A.S.P.'s Bruce medal.[3]

By the 1890s the Harvard College Observatory's budget was second only to that of the U.S. Naval Observatory in the United States. Pickering also used his influence with Miss Bruce and other donors to raise funds for other astronomers. He solicited both donations from philanthropists and what would now be called grant proposals from astronomers, and he made awards to astronomers throughout the world. He even obtained funds for those who had criticized him severely in print. However, his attempt to centralize all American contributions to astronomy in one fund, to be managed by Harvard, was rejected by others, among them the young George Ellery Hale, who would surpass even Pickering as an astronomical fund raiser and empire builder. (Hale received some practical training as a volunteer assistant to Pickering while a student at M.I.T.)

The acknowledged pioneer at bringing large numbers of women into astronomy, Pickering is sometimes criticized today for not having the sensibilities of the 1990s in the 1890s. While it is true that his women employees were paid less than the men in the observatory, he fought the administration for years before getting Mrs. Fleming the first official appointment of a woman at Harvard, that of Curator of Astronomical Photographs. He nominated her at least three times for the Bruce medal, and he also nominated Mrs. Draper for the 1906 medal. He spent a substantial amount of time and of his own funds to help the builders of astronomy programs at women's colleges.

Although astronomy was his passion, Pickering had other interests, ranging from music (he owned more than 500 records in the very early days of recording) to mountain climbing (he was the first president of the Appalachian Club).

His most important personal discoveries were of one of the first spectroscopic binary stars (made simultaneously with H. Carl Vogel in Germany) and of the series of spectral lines known as the Pickering series, later found to be due to ionized helium. But they were far overshadowed by his achievements as an administrator, the builder of an enormously successful research institution. ■

3. See "A Brief History of the Catherine Wolfe Bruce Medal of the A.S.P.," *Mercury*, Jul/Aug 1986.

For Further Reading

Bessie Zaban Jones and Lyle Gifford Boyd, *The Harvard College Observatory: The First Four Directorships, 1839 - 1919* (Harvard University Press, Cambridge, MA 1971).

Howard Plotkin, "Edward Charles Pickering," *Journal for the History of Astronomy*, v. 21, part 1, p. 47 (1990).

John B. Hearnshaw, *The Analysis of Starlight* (Cambridge University Press, Cambridge, UK, 1986).