HARLOW SHAPLEY AND HIS SUPPORT FOR THE AAVSO

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Abstract

This paper summarizes Harlow Shapley's career in variable star studies. It then cites examples of his support of the AAVSO with funds, facilities, teambuilding, and research initiatives.

1. Introduction

Twenty-five years ago, the American Association of Variable Star Observers (AAVSO) lost a good friend. Harlow Shapley, for many years Director of the Harvard Observatory (HCO), died 20 October 1972 in Boulder, Colorado. His career in variable stars was long and illustrious. Annie Jump Cannon, Harvard's astronomical giant, knew him as "always keen on variables" (Cannon 1935).

Stellar variability fascinated Harlow Shapley. People fascinated him more. Following him on daily rounds at HCO, one saw that he knew just what everyone was doing—and how and why. This writer, hospitalized in 1951, received a hand-written note: "Sorry to hear of your mysterious woes. But [the doctor] says you'll be O.K. rather soon. Meanwhile .... have a good time! Yours, HS" (Shapley 1951).

The rest of the note told who was managing the darkroom in the interim, and how a recent research report went at the "hollow square." "Hollow squares" were discussions showcasing progress reports by staff and visiting researchers held around tables put together to form a hollow square in the center. The sessions were quite democratic; even entry-level clerks attended. The square table arrangement suggested teamwork, rather than hierarchy. Shapley forged long-term friendships with many of his staff and students; even now, his friends are eloquent in their praise of his keen mind and warm heart. Detractors deem his mind and heart skewed by vanity. His whirlwind personality defies all stereotypes: he was an original.

2. Shapley's career in variable stars

After a non-traditional early education, Shapley entered Missouri University in 1907. There he observed variable stars in 1910. He used a 7½-inch Clark refractor with a balky photometer (Shapley 1969). Missouri awarded him his A. B. degree that year in mathematics and physics, and in 1911, his M.A. While working on his master's degree at Laws Observatory with Frederick H. Seares, he won a Thaw Fellowship in astronomy from Princeton. Seares later became Shapley's most influential mentor (Bok 1978).

Two-and-a-half years in a Ph.D. program at Princeton with Henry Norris Russell gave Shapley the tools for a lifelong involvement with variables. Obtaining the orbits of eclipsing binaries was his major task. His thesis in 1913 on the orbits of 90 eclipsing binaries "virtually created in one stroke a new branch of double-star astronomy" (Kopal 1972).

Shapley now needed a job. Late in his thesis process, he wrote Seares, already at Mount Wilson Observatory, Pasadena, California. What were the chances of joining the staff there? Seares wrote back, "I think we can fix that all right" (Shapley 1969).

After a meeting with Mount Wilson Director George Ellery Hale in New York City, Shapley had his job. It was early 1914, he was 28, and his eye was on the world's largest telescope, the 100-inch Hooker (then being built and to see first light in 1917).

Before traveling west, Shapley visited Edward C. Pickering, Annie J. Cannon, and Solon Irving Bailey at Harvard College Observatory. Those three Harvard luminaries made a lasting impression on him. In later years, Shapley often told how persuasive Bailey was in urging him to undertake the study of Cepheids in globular clusters. Mount Wilson's 60-inch reflector would be ideal, Bailey said. He himself had recently done extensive research on such variables from Harvard's Boyden Station in Peru. This station (moved in 1927 to South Africa) was to give Shapley a unique view of the southern Milky Way. For over two decades no one else had such good access to the Magellanic Clouds.

Shapley's Magellanic Cloud work was an extension of his great achievement of estimating quite creditably the dimensions of the Milky Way. Once at Mount Wilson, the young Ph.D. began to investigate whether Cepheids in globular clusters could be used to locate the galactic center. Surmising that the clusters formed a "halo" around the center, he used those stars as "yard-sticks" to find the distance to that center. Most astronomers then thought Cepheids were binary stars; Shapley showed they were pulsating single stars. His landmark work charting our galaxy via Cepheids was entitled "Remarks on the Arrangement of the Sidereal Universe" (1918). The Cepheids he used were RR Lyrae stars (then known as "cluster variables"), plus what were later to be called "classical Cepheids."

Shapley's 1917–1919 work relied on research by Harvard's Henrietta Swan Leavitt. Discovering 1777 new variable stars in the Small Magellanic Cloud, and obtaining the periods for 25 of them (later classified as Cepheids), she found a ratio between period and magnitude (Leavitt 1908): increasing periods matched increasing magnitudes. Miss Leavitt concluded, "Since the variables are probably nearly the same distance from the Earth, their periods are apparently associated with their actual emission of light..." (Pickering 1912).

The term "luminosity-period curve of Cepheid variation" was first used by Shapley in his paper, "On the Determination of the Distances of Globular Clusters" (Shapley 1918). Gingerich (1975) discusses Shapley's creativity in overcoming the problem of calibrating a Cepheid's absolute brightness:

> Because no Cepheids are close enough to be measured by direct trigonometric methods, [Shapley] relied on an ingenious statistical procedure to establish the distance and hence the luminosity of a typical Cepheid variable.

According to Shapley (1969),

> The result (of the 1917–1919 research) was what might be called a three-dimensional picture of our galaxy . . . In it the solar system is off center and consequently man is too. Here was an indication that we were perhaps incidental.

At that time, the full extent of interstellar obscuration was not known. Thus Shapley's value for the galactic diameter was some 300,000 light-years, versus the current value, about 100,000 light-years (Hoskin 1982).

Shapley's finding was revolutionary. In response, in 1919, Hale scheduled a pair of lectures on the subject for 26 April 1920, at the Annual Meeting of the National Academy of Sciences in Washington, D.C. In this so-called "Great Debate," Shapley gave his new galactic data. Heber Doust Curtis of Lick Observatory, Mount Hamilton,

California, defended his view that the clusters were much closer to Earth, and the galaxy, smaller. Shapley's position prevailed. With spiral and ellipsoidal nebulae, however, Shapley's conclusions proved wrong. He took these objects for "relatively minor satellites to the Milky Way system." Curtis' argument that they were "island universes in their own right" was correct (Bok 1978).

Discussion continues to this day on whether Shapley's career was helped or hindered by his "debate" performance. Nevertheless, his resumé was already impressive. After a staff position was offered to Shapley at Harvard, Harlow and his wife, Martha, had to make a big decision. Leaving Mount Wilson meant leaving the most powerful telescope in the world. But the possibility of taking the helm at HCO meant international preeminence. The Shapleys moved.

Shapley's new role allowed him to focus more intensely on specific variable star researches:

> A major new phase of Shapley's career began in 1921, when he was appointed [temporary] director of Harvard College Observatory [becoming "permanent" fifth director within seven months] and Paine professor of astronomy ... . The 1920's and 1930's were his glory years. Although his researches ranged far and wide, he concentrated on variable stars, especially those in the Magellanic Clouds. (Bok 1972)

> One star that has long been Shapley's favorite—and which is still not understood—is S Doradus, the peculiar variable star in NGC 1910. Shapley has noted that S Doradus is probably intrinsically the most luminous star known to us. (Bok 1965)

Shapley extended the findings of Henrietta Swope to refine the value of the distance to the galactic center. From this Shapley-Swope collaboration of the mid-1930's, Cecilia H. Payne-Gaposchkin saw that "variable stars were serious business in astronomy now. In the hands of Henrietta Swope, the Harvard programs on variable stars in the Milky Way were bearing fruit in enormous quantities" (Payne-Gaposchkin 1996).

> Writing to Payne in March of 1923, Shapley had suggested that her greatest opportunities for rewarding research at Harvard lay in the photographic study of variable stars. Payne replied that she was much interested in variable stars, and Shapley recommended reading on the subject. Once Payne arrived in Cambridge, however (September 1923) Shapley rapidly discovered that she was even more interested in ... the physical interpretation of stellar spectra. (Payne-Gaposchkin 1996)

Over time, as Payne built an international reputation with stellar spectra, she did not forget variables. The 1930's saw a massive survey of variable stars by Payne-Gaposchkin and her husband, Sergei Gaposchkin. The results of their efforts are found in *Variable Stars, Harvard Observatory Monograph No. 5* (Payne-Gaposchkin and Gaposchkin 1938).

Shapley mentored them both. Cecilia Payne came to the U.S. from England specifically to study with him. Her future husband moved to the U.S. from Germany in 1934 through Shapley's intervention. Gaposchkin was one of the European scholars brought to safety in the United States through the joint work of a number of American centers of higher learning (Jones 1984). He served at HCO till his retirement in 1965.

Among Director Shapley's several other colleagues was Mrs. Virginia McKibben Nail. In the early 1950's this writer worked with Mrs. Nail, computed many Cepheid

periods, and was fortunate enough to discover Nova Doradus 1948 on one of the plates of the Large Magellanic Cloud (Henize, Hoffleit, and Nail 1954). AAVSO's own Margaret Mayall spent almost all her professional life in close collaboration with Harlow Shapley and his variable stars. It would require another paper to do justice to her role. She was a kind of cement binding the AAVSO to HCO.

3. AAVSO sponsorship

Shapley inherited AAVSO sponsorship from the former HCO Director, Edward Pickering, who had relied for at least a decade on amateur observers in England to supplement what he and his staff could do. The dream of an American counterpart came together in 1910, during a discussion between William Tyler Olcott and Pickering (Waagen 1996). The following year the AAVSO was founded. Shapley, on arrival in Cambridge ten years later, found the Association thriving. So great was his influence that the AAVSO has been called "an extension of Harlow Shapley's long shadow" (Robinson 1990).

Shapley's aid to the AAVSO included (1) fund raising, (2) facilities use, (3) teambuilding, and (4) research initiatives.

3.1. Fundraising

Sustained research takes long-term financing. Shapley worked hard to make the Association financially independent. In 1921, the AAVSO Council proposed an Edward C. Pickering Memorial Endowment of $100,000. By 1931, it had raised only $6,356.76. However, that year Shapley stepped in and completed the AAVSO's $100,000 endowment from the Stewart Wyeth Bequest (Robinson 1990). This Edward C. Pickering Memorial Endowment was kept as a part of the Observatory's development fund. The arrangement continued to be adequate until the 1950's.

Significantly, AAVSO archival materials for the 1921–1952 period seldom mention money problems. A small exception occurred at the fall meeting of 1935. For 24 years the Association had paid to have its reports published in *Popular Astronomy*. The membership voted to accept Dr. Shapley's offer to print AAVSO reports quarterly in the *Annals of the Harvard College Observatory* (Leavens 1935). The Director's generosity improved the budget modestly (Hoffleit 1973). It seems that AAVSO management was sound and Observatory relations healthy during the Shapley decades.

3.2. Facilities

The AAVSO was fortunate to have, initially, adequate space within the HCO building complex. On 23 December 1921, Shapley wrote a letter to William Tyler Olcott, AAVSO Secretary, on space allocation for the AAVSO Headquarters in the original Observatory building (later redesignated Building A). A copy of an attachment, giving specific terms, but undated and unsigned, accompanied the letter (Shapley 1921).

The area dedicated to the Association's office and library in the former Building A was described. The use of "the dome above the proposed headquarters, with the telescope pier contained therein, for the mounting of the Charles Alfred Post Memorial Telescope, recently given to the Association" was set.

In 1931, an enlarged Building D was built and its Phillips Auditorium became the site of AAVSO annual fall meetings. The Director's Residence and its grounds were supplied for social events and Council meetings during the next two decades.

When Shapley retired, the AAVSO lost its HCO office space, as well as its endowment. Margaret Mayall, serving first as AAVSO Recorder, with a title change to Director in 1954, described Shapley's response to these developments. She stated,

"Shapley almost cried when he said he could do nothing for us" (Robinson 1990).

This writer will not retell the events by which the AAVSO has achieved its present financial independence and occupied its present facilities. Many have told this story, and told it well. (See, for example, Ford 1986; Mattei 1986.)

3.3. Teambuilding

Fine facilities build group pride. A world-class university, preeminent in astronomy, took a private research group under its wing. Shapley strengthened the relationship. His attendance at AAVSO meetings was regular and spirited. Minutes of the October 5–6, 1945, meeting noted that Dr. Shapley, then in England, was missing his second annual meeting since 1920 (Buckstaff 1945).

An extraordinary sense of community prevailed at HCO in Shapley's day. In an interview with Owen Gingerich, August and September 1986, Margaret Mayall remarked, "In the 20's and early 30's all the Observatory people sort of considered themselves members of the AAVSO. It wasn't until Leon Campbell retired as AAVSO Recorder that people outside the Observatory realized that the AAVSO really was an independent organization" (Robinson 1990). Such a close tie benefited both institutions.

Shapley was listed as an Honorary Member in a January 1923 AAVSO membership list. He served as First Vice-President, 1932–1935, and as President, 1935–1937. His annual "Highlights in Astronomy," given at fall meetings, became legendary (Hoffleit 1992). In 1951, the Association awarded Shapley its Tenth Merit Award "on the occasion of his 30th year as Director of HCO and guiding light of the Association, and for his international recognition in the field of variable stars."

Shapley personally made extensive use of Harvard's vast photographic plate collection, and he let specific AAVSO researchers use it, but he himself had mixed feelings about doing visual observing. It was exciting for him as "a beginner" to use the 60-inch reflector at Mount Wilson, but "observing was always very hard work," particularly during "long, cold nights" (Shapley 1969). Indeed, as biographer Bart Bok noted, "[Shapley] did not like observing, [but] hated it. He thought it . . . necessary, but . . . a dull thing to do" (Levy 1993).

AAVSO records give Shapley a lifetime total of one observation, made in November 1942. An extensive search of AAVSO Headquarters has failed to find a report form or mention of which star he observed.

Shapley's correspondence, though, shows his pride in the AAVSO. In late 1933, a letter came from Mr. Louis W. Hickey of Dallas, Texas. Mr. Hickey asked what AAVSO membership would involve for a young friend of his. (The friend was never named.) On 9 November, Shapley replied,

> The American variable star association was conceived, midwifed, nursed, and reared through its adolescent stages by the Harvard Observatory. Its headquarters are at the Harvard Observatory; its vice president, recorder, and recorder's assistants, are members of the staff. Its library, lantern slide collection, and records are all here. I think your friend is undoubtedly an informal associate of the Harvard Observatory; and if he is as good as some of the other Texas group he is a highly creditable scientific citizen.

The letter concluded, "Very sincerely yours, H.S., Vice President, American Association of Variable Star Observers and principal irritant and instigator" (Shapley 1933). On 21 November 1933, Hickey replied to Shapley, thanking him for his assistance, and stating "how deeply pleased" the friend was to have been admitted to AAVSO membership (Hickey 1933).

The HCO Director boosted the AAVSO, even though a risk could be involved:

> The AAVSO does really good work besides absorbing the energies of

> amateurs. We got special gifts from amateurs to support it. We didn't spend a great deal of money.... Building up the AAVSO was really a serious contribution that the Harvard Observatory made to astronomy. Many observatories fear a loss of prestige if they deal with amateurs. We had some difficulties, but we set the pace, and others went along. (Shapley 1969)

3.4. Research Initiatives

In particular, Shapley spurred AAVSO research. On 19 May 1933, he wrote to then-President Professor Harriet W. Bigelow of Smith College to suggest the organization spend more time on bright irregular variables:

> I have asked Miss Payne to present her ... important study ... of the variable star W Orionis. There are a number of stars of this sort, many of them Class N variables. The importance that they must have in theories of long period variation and of instability and evolution of giant red stars leads me to inquire if a systematic effort might not be made by the better observers in the Association to follow these irregular stars regularly.
>
> I think it might be possible, while Miss Payne is at the meeting, to invite her cooperation in providing the necessary magnitude sequences. Perhaps something can be done towards establishing these sequences visually, or checking whatever photovisual magnitudes may be obtained easily.
>
> Some of these variables of this irregular type go through their fluctuations so rapidly that the Harvard sky patrol is insufficient to follow them. Also we are not following stars systematically in red and yellow light and it is likely that the change[s] in color index and spectral characteristics are as significant for this kind of variable.
>
> ... I believe it would be advisable for the Association to substitute some attainable irregular variables for a number of the periodic stars of Class M. It is important to keep many of the Class M variables because of the changes in period; but none of them offers the interesting problem in cyclic changes, semi-cyclic variations, and plain exciting irregularities afforded by the peculiar Class N variables... . (Shapley 1933)

So great was the enthusiasm over this challenge that at the 19 May 1933 meeting in New London, Connecticut, "several observers offered at once" to join the project (Furness 1933).

In April 1934, Leon Campbell, AAVSO Recorder, sought to keep alive the enthusiasm:

> Steps have been taken to increase our observing list not only by the addition of more sequences furnished by the Vatican-Harvard combination of observers but by the addition of some especially important stars having multiple periods, or periods within 12 periods. You heard about these at the New London meeting. (Campbell 1934)

Subsequent *AAVSO Variable Comments* also mention "the red star program." A related initiative came in 1938:

> A year or so ago, Dr. Shapley ... proposed a photographic program to those who are sufficiently equipped and enough interested, aside from the usual visual work .... He made it possible for members and others to obtain

> photographic equipment, both new and old, so that we are now ready to launch a definite program....
>
> More photographic outfits, and persons to put them to good use, are needed ....
>
> Our visual program [is] divided into two main parts: regular long period variables, such as R, S, and T Ursae Majoris, omicron Ceti, chi Cygni, etc.; and special variables, such as R Coronae Borealis, R Scuti, SS Cygni, etc. The observing list now contains approximately 500 variable stars, and for most of these stars very completely observed light curves have been obtained, so that we can state definitely just what has happened to each of these stars during the past 25 or more years. (Campbell 1938)

Getting cameras for AAVSO observers is just one example of Shapley's taking amateur astronomers seriously. His helping not only the AAVSO, but also the Astronomical League (Robinson 1986), the Bond Astronomical Club (Robinson 1991), and the Amateur Telescope Makers of Boston shows his respect for those who scan the sky just for the love of it. He saw professional and amateur astronomers together fighting the "Tyranny of the Unknown" (Shapley 1963).

4. Conclusion

Harlow Shapley aimed to expedite "the widening spread of scientific habits of mind throughout the entire body politic" (Mather 1971). To this end he organized for HCO the "hollow squares" mentioned above. He chaired "owl sessions" (late-night scientific chats) during summer conferences at Star Island, off Portsmouth, New Hampshire. He wrote numerous books, mostly for the non-specialist. He used radio talks creatively to heighten public interest in science. No private school, civic club, or church was too small to merit his appearance. Favoring small and minority colleges (Bok 1978), he gave talks in a dozen countries.

This man of the world would rejoice in the AAVSO's contribution to the international Hipparcos survey. He would cheer the Association's increasingly global membership and added overseas meeting venues. At the same time, he would solidly support such local actions as Hands-On Astrophysics (Mattei *et al.* 1995) and mentoring of new members. He himself was a fine example of thinking globally and acting locally.

Presently the AAVSO's role in stellar research is accelerating. Its growing membership is enlarging the body of over 8.5 million observations of variable stars already compiled. As the Association moves on into the 21st century, may it look to new challenges in the positive spirit of Harlow Shapley.

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