SHAPLEY'S IMPACT

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ABSTRACT: Harlow Shapley's legacy can be divided into three aspects: his scientific contributions, the institutions he built, and his multi-faceted efforts to publicize astronomy. Today's public funding of science undoubtedly owes much to Shapley's enthusiasm for astronomy.

It was almost four decades ago that I came to work as a summer assistant for Harlow Shapley, an event destined to turn me toward professional astronomy. Thus perhaps even I can be considered a minor example of Shapley's impact. However, this doesn't make it much easier for me to summarize Shapley's influence in a few pages. On the other hand, the fact that I helped him prepare his memoirs, *Through Rugged Ways to the Stars*, does help. At the time I suspected that Shapley subscribed to the old adage that one must not let truth stand in the way of a good story, and so I took some trouble to check out those tales that loomed bigger than life in his account. To my surprise, I could verify one story after another. Yes, he really was the man who almost single-handedly added the S into UNESCO. Yes, he really did find academic places for numerous refugees from Nazi and Fascist tyranny in Europe. And yes, he did pickle in vodka an ant collected from Joseph Stalin's banquet table.

To probe into Harlow Shapley's legacy, I think we must briefly explore three aspects: his scientific contributions, the institutions he built, and his astonishingly wide reputation as a spokesman for astronomy. These areas blend seamlessly into each other, but let me try to separate them. I shall begin with a few remarks on his scientific achievements.

The period-luminosity relation was neither Shapley's discovery, nor was he the first to apply it. Yet, by the dramatic results he achieved with it, he effectively made the period-luminosity relation his own. Thus, when Edwin Hubble found the light curves for several M31 Cepheids, it was to Shapley at Harvard that he turned for the most up-to-date calibration of the relation. On February 27, 1924, Shapley responded to Hubble saying:

J. E. Grindlay and A. G. Davis Philip (eds.),
The Harlow-Shapley Symposium on Globular Cluster Systems in Galaxies, 23–33.

Your letter telling of the crop of novae and of the two variable stars in the direction of the Andromeda nebula is the most entertaining piece of literature I have seen for a long time.

Note that Shapley didn't say "*in* the Andromeda nebula" but "in *the direction of* the Andromeda nebula." Shapley must have realized that his debating position of just a few years earlier was crumbling, and he made one final parry of resistance. Even though Shapley had in 1917 found one of the novae in M31 and had suggested a distance of a million light years, he had hastily back-pedaled after devising his new model of our galaxy. Without interstellar absorption our Milky Way seemed so enormous compared to the spirals that it appeared to be a cosmic unit of altogether different proportions. In the 1920s Shapley thought of the Kapteyn universe as one cloud of an enormous flattened assemblage, a supergalaxy as he called it. The familiar cross section with the globular clusters in their halo-like array was *not* the model Shapley had in mind then—the familiar old picture is from J. S. Plaskett's Halley Lecture of 1935. Even after Trumpler's discovery of interstellar absorption in 1930, the anomaly persisted; and I shall return to this question at the end of my paper.

Meanwhile, let me remark on Shapley's own scientific work at Harvard. Here he was hampered both by weather and by the lack of the big telescopes that he had used so effectively at Mount Wilson. Hence he followed in Pickering's footsteps as an astronomical administrator, organizing large scale surveys—of spectral classes, of variable stars, of stellar magnitudes; for himself, he chose galaxies. The Shapley-Ames catalog of bright galaxies was one result. Another was his forceful demonstration of the inhomogeneity of galaxy distributions, an area in which the CfA is once again in the forefront.

A result of these investigations, in 1937, was the discovery of the Sculptor and Fornax dwarf galaxies. One of the women who counted galaxies for him on these large A plates from the South African station noticed a peculiar peppering of fine stars, almost like a thumbprint, and called Shapley's attention to it. He soon recognized that it was a new class of objects, unlike any galaxies that had been seen before. In such a case we might well ask who really discovered the Sculptor system: Was it the person who master-minded the investigation, who raised the funds and set the survey into motion, or Sylvia Mussells, who went beyond her immediate instructions of marking galaxies and who noticed the smudge? Was it the person who found the smudge or the one who figured out its significance? These are questions that, in their many guises, historians of science must struggle with, but in general the historical interest lies not with the person who first saw an object or who first grasped a theoretical idea, but with the one who recognized and exploited its significance.

In our era of big science, such questions have increasing poignancy when one plants and another reaps. Harlow Shapley lived in a transitional age, already inherited from Pickering and even from George Ellery Hale, when an effective scientist-administrator could marshall forces beyond a single person's capacity, bringing not only to himself but to his colleagues or assistants resources that they might not otherwise have. Such was to a large extent Shapley's role at

Harvard, and if he himself made no discoveries as grand at Harvard as he had in those heady days at Mt. Wilson, we should hesitate to judge that it was a mistake for him to leave the clear skies of southern California. To very few is given the chance to change our conception of sidereal structure as much as Shapley once did, and to have asked him to do it again at Harvard is demanding rather much. And we must ask as well, did he not play a key role here as a catalyst for his colleague's discoveries? Surely the answer is yes! So this brings me to the second aspect of Shapley's legacy, his role as builder of institutions.

In four decades as director, Edward Pickering had turned the Harvard College Observatory into a world-class research establishment. But astronomy education at Harvard took place not on Observatory Hill, but with an entirely different staff in the astronomical laboratory, a frame building that stood just north of the Harvard Yard. Once in an undergraduate career there was an opportunity to see the real observatory, when seniors lined up two abreast to march up Garden Street to visit Pickering's domain. As for graduate students, there may have been some apprenticeships, but surely no formal degrees. Shapley's approach was obviously different, and not many years after his arrival he seized an opportunity to work toward an astronomy graduate program.

In May of 1922 Shapley had gone to the Rome IAU meeting, and later in the month he spoke briefly about the spectrographic work at HCO at the centenary meeting of the RAS in London. Among his fascinated listeners was Cecilia Payne, then a Cambridge undergraduate, who boldly told him after his lecture that "I should like to come and work under you." Shapley cheerfully agreed; but it undoubtedly surprised him when she eventually turned up in the American Cambridge.

After about a year Shapley suggested that Miss Payne turn in a thesis for a PhD at Radcliffe College. There was, however, no provision for advanced degrees in astronomy, and Theodore Lyman, chairman of the Harvard physics department, was adamantly opposed to a woman candidate in physics. How Shapley managed to have Payne's doctorate awarded in astronomy is not known, but this event in 1925 marked the birth of the graduate school in astronomy. Soon there were other graduate students, and doctorates including Helen Sawyer Hogg's. As the program expanded, Shapley recruited Harry H. Plaskett from Victoria to teach astrophysics, and on October 18, 1928 he included in a letter to Edwin Hubble the following typically light-hearted note:

> *Curiously enough I find that H H Plaskett has grave doubts about the large distances for extra-galactic nebulae. He is sufficiently serious about it that he and Miss Payne are to debate the subject at a colloquium two weeks from today. If he convinces me, I shall cable you.*

One of the educational innovations Shapley established, beginning in 1935, was the Harvard Summer School in Astronomy, which was deliberately designed to bring together physicists and astronomers. For this he used the famous and influential Michigan summer school in theoretical physics as his model. The Harvard program, the first of its kind in America, introduced graduate students

such as Jesse Greenstein, Leo Goldberg, James Baker, and Lawrence Aller to scientists such as Jan Oort, Ira Bowen, Meghnad Saha, Bengt Edlen, H. P. Robertson, John Slater, Robert Marshak, and George Shortley.

Shapley was particularly proud that he has assembled such an international group at Harvard Observatory, and he delighted in showing a picture taken around 1940 with students or staff from 13 foreign countries. This sort of enthusiastic internationalism, which is so essential to the International Astronomical Union, was eventually to get him in trouble with the House Un-American Activities Committee and with Senator McCarthy, episodes that are also part of Shapley's impact.

I could mention also his role in reforming the American Academy of Arts and Sciences, or the long hours he spent reviewing fund proposals for the American Philosophical Society and for Sigma Xi. These and many more topics you can find in his autobiography, *Through Rugged Ways to the Stars*. If you knew Shapley, you can hear him talking in the book, a raconteur with a splendid combination of vanity and a sly facetiousness that enabled him to poke fun at himself. I always thought he carried a continual air of amazement that a farm boy from Missouri could become a celebrity and meet presidents and dictators and even the Pope.

Something of that quality carried over to the public platform, where Shapley eventually became an engaging speaker and also enough of a journalist to know what made good headlines. He frequently spoke of his own most brilliant achievement, from heliocentric to galactocentric, and I often heard him say that in the old days at Mount Wilson he had no idea of the *philosophical* implications of his research. In fact, that was patently false, as the following letter to George Ellery Hale, written on January 19, 1918, shows:

> *So the center has shifted: egocentric, lococentric, geocentric, heliocentric.*
>
> *Now, getting nearer those serious things that the heartless corporation pays me to investigate, we know that for the last few decades some observing and unheeded astronomers have noted that the Milky Way is not a great circle and that it is brighter in some places than in others. But that is not necessarily our fault. We are not responsible for the imperfections of this Universe. We have indeed held on to that heliocentric center doggedly, in spite of increasing doubts when we troubled to think on the subject analytically. If the center got away from us, we feared that Man, the Ultimate Purpose of Creation, would loose [sic] his hold on all things. Instead of MAN and the universe it might become man and The Universe.*

Harlow Shapley achieved widespread public fame by speaking articulately and imaginatively about the vastness of space, the peripherality of man, and the industry of ants. The Harvard Archives contains an astonishing number of press clippings, beginning in great quantities with his appointment to Harvard in 1921. Let me select a handful to illustrate the extent of his fame.

Here is a telegram signed "Clarence" from Dayton, Tennessee on July 10, 1925:

> *Distinguished colleagues of yours have suggested you might be willing to come to testify for defense at Dayton Tennessee next week in the case of State of Tennessee versus Professor Scopes STOP We of the defense would be delighted to add you[r] authority to our position STOP Your expenses will be paid STOP Will you wire me directly at Dayton and I will let you know what day you will be needed.*

Shapley did not go to Dayton for the famous Scopes trial, but the nature of the invitation is an indicator of his public fame in the 1920s.

In the next decade, we find his picture of the cover of *Time* magazine, on July 29, 1935, in connection with an article on the Paris Congress of the IAU. (Shapley was the second astronomer to gain this distinction, the first having been Arthur Eddington on April 16, 1934.)

"Harvard's Harlow Shapley: From ants on his desk to the Great Nebula in Andromeda."

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RANKIN IN ROW WITH SHAPLEY

Harvard Professor, Accused of Contempt, Charges 'Gestapo Tactics' by House Committee

Headline in a Boston tabloid, 1946.

DR. HARLOW SHAPLEY (right) studies with his attorney, Thomas H. Eliot, the report the Harvard astronomer was reading before House committee today when Chairman Rankin became aroused, allegedly snatching the paper from the witness' hands.

WASHINGTON, Nov. 14 (UP) — Representative John E. Rankin, Dem., of Missis-

In the mid-1940s Shapley's name loomed large in the press on account of his tift with Congressman Rankin and the House Un-American Activities Committee. Shapley's firmly held internationalism and his stubborn independence had attracted the attention of congressional witch-hunters, and so he had been called to Washington to testify. He was not allowed to have a lawyer present in the "Star Chamber" hearings before the congressman, but he recorded the session in the shorthand he had picked up as a fledgling reporter in Kansas decades earlier; Rankin left the hearings saying he had never had a witness treat the committee with such contempt. Banner headlines four centimeters high proclaimed "RANKIN IN ROW WITH SHAPLEY"—little other identification being needed for the local Boston public.

In the 1950s he not only tangled with Senator McCarthy, but also with Immanuel Velikovsky, the Princeton doctor and author of the best selling *Worlds in Collision*. Had Macmillan listed the book as science fiction rather than science, they might have avoided trouble from some of the astronomers. Shapley sent a few letters to the publisher about it, complaining that if *Worlds in Collision* were a science book, Macmillan should have had it refereed. Perhaps his harshest but

most amusing comments were written to them on January 25, 1950:

> *If I remember correctly, several years ago Dr. Velikosky met me in a New York hotel. He sought my endorsement of his theory. I was astonished. I looked around to see if he had a keeper with him... I tried, rather futilely, to explain that if the earth could be stopped in such a short period of time, ... it would have made impossible that he and I could meet together in a building in New York City less than four thousand years after this tremendous planetary event.*
>
> *Dr. V seemed very sad. But somehow I felt he was feeling sorry for me and the thousands of other American physical scientists and geologists and historians who have been so, so wrong.*

Velikovsky's fans claimed that Shapley was instrumental in organizing a boycott against Macmillan, but if so, the Archives show no trace of it.

It was only a few years earlier, when the world was at war, that it came time to celebrate the 400th anniverary of the publication of Copernicus' *De Revolutionibus*. Poland was in bondage, but the American Polish community was determined not to let the anniversary pass without notice, so a grand affair was scheduled in New York. It was symbolic of Shapley's public impact that he was the man who read President Roosevelt's greeting to the distinguished guests, and it was to his observatory that a remarkable painting of Copernicus was given. It still hangs in the entrance to Building A, a magnificent gift to the man who took the step from heliocentric to galactocentric.

Today the scientific principle of mediocrity is often called the Copernican principle: we should not expect to be in the center of things, or in the most splendid galaxy. Even Shapley's galactocentric move might today be called a Copernican maneuver. Shapley was clearly troubled by the fact that the Milky Way seemed to be the biggest of them all, and I remember how, in a graduate cosmogony course that he helped to teach in the spring of 1952, he assigned to Frank Orrall the topic of why the globular clusters in M31 were only half the size of those in our own galaxy. Neither Shapley nor any of the students could come up with an answer. I mention this to show what a viselike grip a wrong assumption can have when it seems to fit so coherently into the rest of the picture.

As you all know, only a few months later at the Rome IAU meeting Walter Baade announced that two different types of Cepheids had been mixed together in Shapley's Mount Wilson work, and that when these were sorted out, M31 was twice as far as had been supposed, the anomalous globular clusters fell into place, and the Milky Way was no longer the unqualified king of the galaxies. Only in retrospect was it noticed by the overwhelming majority of astronomers that the Copernican principle of mediocrity might have pointed the way.

Baade had the advantage of the world's largest telescopes at his disposal, and he was also one of the pre-eminent observers of our century. Would Shapley have made the discovery if he had stayed on at Mount Wilson? Trying to rewrite history as it might have been is a rather fruitless exercise. Did Shapley

lose out in his science by abandoning the giant telescopes of the West? Probably not—as I have noted, few have the chance to make even one discovery as grand—and few have as fine a chance to build astronomy through education, activism, and public appeal. I suspect we all owe much in the public funding of science—foreign as that was to Shapley's instincts—because of this one man's multi-faceted efforts through the press, through the pioneering Harvard radio talks on astronomy (beginning in the 1920s), through the Harvard books on astronomy, and through his own ubiquitious appearances on the lecture circuit to arouse in an interested public a curiosity and fascination with topics astronomical. Thus it is entirely appropriate that the American Astronomical Society has instituted the Shapley lectureships to help in the public understanding of astronomy. I think it was inappropriate for the International Astronomical Union to refuse to recognize the Shapley centennial when it fell directly on the dates of the Congress in India last November, but fortunately we are now having the opportunity to commemorate this remarkable man under IAU as well as Harvard auspices with a topic that was always dear to his heart, globular clusters.

ACKNOWLEDGMENTS

I should like to thank the Harvard University Archives for permission to quote from letters in the Shapley collection, and the Shapley family for making many of the materials available to me and to the Archives. Michael Hoskin and Richard Berendzen originally showed me important pieces of the astronomical correspondence related to Shapley's career, which I deeply appreciate.

DISCUSSION

TRIMBLE: Could we ask for a show of hands of those persons who knew, or met, Shapley personally.

EDITOR'S NOTE: About a third of those present, heavily concentrated towards the front of the room, raised their hands.

HANES: You commented on Shapley's bemusement in early 1952 over the discrepant sizes of globular clusters in M 31 and the Galaxy, subsequently resolved when Baade announced the recognition of two separate kinds of Cepheids. However, de Vaucouleurs has pointed out that there was some work in the years leading up to 1952 that independently suggested the need for revision in the extragalactic distance scale. Did Shapley have any intimations of this?

GINGERICH: I am glad that you asked this question, because I specifically researched part of this point in preparing my paper. After Baade's announcement at the Rome IAU, Henri Mineur in Paris claimed that nearly a decade earlier (in 1944) he had shown the difference in zero points for the RR Lyrae stars and the Cepheids. However, he apparently had no inkling that two different P-L relations were involved, and he did not understand or believe this result enough to make a simple prediction such as: you ought to be looking for RR Lyrae stars about a magnitude and a half fainter in the Magellanic Clouds, which is precisely what Shapley did after he heard Baade's announcement.

Meanwhile Knut Lundmark had in 1948 argued that by using the novae and globular clusters as distance indicators, the distance to M 31 came out to 1,700,000 light years. He admitted that a new proper motion analysis of 100 Cepheids gave the same zero point calibration that Shapley had got, so this must have been the dilemma that Shapley was worrying about when he tried to figure out why the M 31 globulars had the "wrong" luminosity.

It seems to me that in both these cases there is a parallel with the situation so astutely analyzed by Otto Struve concerning whether Bessel or his great-grandfather deserved the credit for finding the first stellar parallax. Struve concluded that astronomers could know that his illustrious ancestor had the right answer first (in 1837) only <u>after</u> Bessel had done his work in 1838.

I think that neither Shapley, who followed the literature fastidiously, nor anyone else could really appreciate what Mineur's paper had hidden in it until the dramatic and convincing demonstration by Baade that there were two different variable star populations. Similarly, it was hard to appreciate that Lundmark was on the right track until the riddle of the Cepheids had been cracked.

OSTRIKER: We learned from Helen Sawyer Hogg that Cecilia Payne was the first Ph.D in Astronomy at Harvard. What other U. S. institutions were there awarding Ph.D degrees at that time or earlier in Astronomy?

GINGERICH: Before World War II only six graduate institutions in America granted doctorates in Astronomy: Yale, Michigan, Berkeley, Chicago, Princeton and Harvard. Quite possibly Harvard was the last to join this list.

DEMARQUE: The first Ph.D in Astronomy was awarded at Yale in 1877.

LILLER: You mentioned that you listened to a course from Shapley in 1952. Isn't it true that Shapley never taught a course while he was director?

GINGERICH: Shapley rarely gave a formal course, and this one was actually a team-taught course on stellar evolution with Bok, Payne-Gaposchkin, and Whipple sharing the lectures with Shapley. He did, however, offer an "Introduction to Cosmogony" course in the 1949 summer school, and one of the things I did that summer was to make lantern slides for the course. One evening he came by my office and told me that he had once tried to make his own lantern slides, for the first AAS meeting he had attended, at Pittsburgh in 1912. He said that after he got to the meeting and realized how much more elegant everyone else's slides were, he spent all his lunch money to have his slides remade professionally!

ZINNECKER: Was Shapley the first to discover dwarf spheroidal galaxies, and did he compare their loose structure to the much more compact structure of globular clusters?

GINGERICH: Certainly yes as far as our local family is concerned. At the time there wasn't anything else like the Sculptor and Fornax systems.

RICHER: Could you detail the reasons why Shapley was brought in front of the McCarthy hearings?

GINGERICH: Dr. Shapley's oldest son, Willis, is here today and can answer that better than I.

SHAPLEY, W.: Rankin was a Mississippi Congressman who had become Chairman of the House Un-American Activities Committee in the years immediately after World War II. This Committee was notorious in its indiscriminate labelling of academic and other liberals as "communists" and in its unfairness to the rights of those accused. Harlow Shapley had been outspoken in support of liberal causes of the period, including civil rights and opposition to the "Cold War" policies of the Government, which he viewed as provocative of a military confrontation between the US and the USSR. Like many others he was publicly branded

a "communist" by the Committee and then subjected to questioning in secret session. His resistance to this process was also highly publicized at the time and was instrumental in bringing about rules changes giving the witnesses the right to have counsel present at all hearings of the Committee.

LILLER: Was it true that Shapley was asked to run for Governor of Massachusetts in 1948 by the leftist Henry Wallace?

SHAPLEY, W.: In 1948 Harlow Shapley had joined former Vice President Henry Wallace and others to form the liberal-oriented Progressive Party to support Wallace for President. The Massachusetts organizers of the Progressive Party asked him to be their candidate for governor, but he declined. He broke with the Progressive Party after their convention at which the Communist element within the party demonstrated their control of it by voting down a platform plank that would have condemned Communist as well as Fascist dictatorships.

McCARTHY: Shapley was writing at the end of his active research work in the years just before and just after his retirement at Harvard (1952). He saw how important red giants and supergiants were for the study of structure and evolution. It was a time of great changes in astronomy (The P-L relation zero point was revised by Baade; new telescopes were coming into use in Southern Hemisphere). Limitations for Shapley were the lack of spectral types for faint(!) 14th-18th mag stars and the lack of radial velocities to discriminate members from field stars. He used "what he had" and looked forward to larger telescopes and better detectors to study evolution effects and population differences in the clouds.

HANES: What happened to the famous rotating desk of Harlow Shapley? It seems like a marvelous idea for efficient work?

GINGERICH: Shapely's rotating desk was originally acquired by Pickering from the Gift of 1905. Now Dr. Shapely's son Alan has it in Boulder, but it will eventually be returned to the Observatory and set up in a museum room for that period.