

NATIONAL ACADEMY OF SCIENCES

HARLOW SHAPLEY

1885—1972

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*A Biographical Memoir by*  
BART J. BOK

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*Biographical Memoir*

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Harlow Shapley

## HARLOW SHAPLEY

*November 2, 1885–October 20, 1972*

BY BART J. BOK

**H**ARLOW SHAPLEY was born November 2, 1885, on a farm five miles from Nashville, Missouri. He was one of fraternal twins. Besides his twin, Horace, he had one older sister, Lillian, and a younger brother, John. He went to school in Jasper, Missouri, but he did not go at first beyond elementary school; he and his brother John had a brief period in a normal school, where they were only permitted to take a business course. At the time when most boys would go to high school, Harlow studied by himself at home. He had one year of early schooling in Hampton, New York, where he went on a family visit. At the age of fifteen he became a crime reporter for the *Daily Sun* in Chanute, Kansas, and he also worked off and on as a police reporter for the Joplin (Missouri) *Times*. He learned to take notes in shorthand, which, in later life, became a medium of communication between him and his wife. In Chanute he found a Carnegie library, and there he really started reading and studying on his own. When funds became available, he and his younger brother, John, decided to go to Carthage High School, a prestigious school located in the nearest city to Nashville, Missouri. The boys were refused admission because of an apparent lack of adequate preparation, but they were admitted to the less-prestigious Presbyterian Carthage College Institute. Harlow Shapley completed the equivalent of six years of high

school training in one year and a half, and he was valedictorian of his class!

We should note briefly that the Shapley family came originally from the Hampton, New York, area, where Harlow Shapley's father and mother were born and raised. They were married just before Harlow Shapley's father, then a teenager of the 1870s, decided to "Go West." To go back further in family history, the Shapleys lived in Connecticut during the revolutionary war period. There is still a monument—so tells Martha Betz Shapley—on the banks of the Connecticut River to commemorate a brave deed by a young Shapley, who swam across the river into territory held by the British. He had been assigned the task of delivering a message to a group of colonists. The boy apparently made the trip across the river and back safely and did deliver the message. There is an old "Shapley House" somewhere in Connecticut facing the ocean.

To return to the Shapleys in Missouri. Horace was not interested in being properly educated, at least not until late in life. He was the one who wished to stay on the land and manage the family homestead. Harlow was quite different. In 1907 (at the age of almost twenty-two), he entered the University of Missouri. He had intended to study journalism, but when he arrived he found that there was no journalism school as yet. As he intimates in his autobiography, it was almost by accident that he selected astronomy as his special field of study. He was very fortunate at the University of Missouri to find some first-rate teachers, some of whom became quite famous in later life. One of these was Frederick H. Seares, who ultimately became one of the leading staff members of Mount Wilson Observatory. Harlow Shapley first met Seares when he started looking for a job on campus. He became an assistant to help run the small campus observatory. In mathematics he had two teachers who are very well known, Oliver Kellogg and Earl Hedrick. Seares was truly Harlow Shapley's mentor. Quietly but thoroughly,

Seares looked after his charge and gave him the opportunities he deserved.

Harlow Shapley received the A.B. degree from the University of Missouri in 1910. He stayed on for an additional year, and in 1911 he received the degree of A.M. Through his reading of the classics, Harlow Shapley had become much interested in Lucretius and in Horace. His first printed paper appeared in *Popular Astronomy* in 1909; it was entitled "Astronomy in Horace." It was also during his years at the University of Missouri that he met his future wife, the brilliant and wonderful Martha Betz. During his final year at the University of Missouri—at the suggestion of Oliver Kellogg—he applied for and was awarded the Thaw Fellowship at Princeton University Observatory.

Harlow Shapley went to Princeton in 1911. Princeton had a small but distinguished astronomical faculty. Henry Norris Russell headed the Department and held the fort as one of the prominent and well-known astronomers of the day in the then-young field of astrophysics. Raymond Smith Dugan was the competent and hard-working observer of variable stars. Right from the start, aristocratic and Presbyterian Henry Norris Russell and Harlow Shapley, the country boy from Missouri, hit it off very well; and the next two years witnessed the development of a beautiful collaborative effort between them. Together they worked out the theory for the analysis of light curves of eclipsing binaries, a theory that even today dominates analysis in this area. Through his close collaborative efforts with Russell and Dugan, Harlow Shapley became impressed with the potentials for research presented by the double stars, especially eclipsing binaries, which reveal many secrets about stars and their physical properties through analysis of their light curves and related spectrographic data. Rough masses and distances were computed for many of the stars under investigation, and amazing new results were obtained through the analysis, especially data about the

dimensions and average distances and also the masses of the component stars. Russell's interest was primarily in the physics of the stars, but Shapley from the start thought in terms of exploring the depths of the universe. He saw the eclipsing binaries as potential standard candles observable to great distances from the sun and earth. We note here that Martha Betz Shapley in later life became an experienced and expert analyst of orbits of eclipsing binaries. Shapley's doctoral dissertation, which was ready for examination two and a half years after his arrival at Princeton, dealt with the properties of eclipsing binaries. His thesis has become a classic in the field.

It is worth noting here that Harlow Shapley was exceedingly fortunate in the teachers that came his way, first at Missouri and later at Princeton. The five whose names I have specifically mentioned—Seares, Kellogg, Hedrick, Russell and Dugan—were all tops in their fields of chosen endeavor and they truly helped direct the career of young Shapley. Two lessons emerge from this: First, young people who at early stages in their careers meet the truly great are indeed happy fellows; second, men and women of accomplishment have an obligation to search out the best young people that come their way and assist them in every possible way in shaping their careers.

During his Princeton days, Harlow Shapley studied the cepheid variable stars, which were at that time generally suspected of being a type of binary star. From discussions with Russell, it soon became clear that the binary star hypothesis was untenable; and the two developed a new theory to explain the variations in light, color, and radial velocity for the cepheid variables. Nothing much was published on the subject during the time that Shapley was still at Princeton, but shortly after his arrival at Mount Wilson Observatory (1914), he completed a paper, "On the Nature and Cause of Cepheid Variation," in which he showed that cepheid variables are most likely pulsating single stars. In modified form, the pulsation theory still holds sway.

The years 1913 and 1914 were momentous ones in the life of Harlow Shapley. In 1913, he and his brother John made a five-month trip to Europe, during which Harlow Shapley met many of the leading European astronomers. During this trip, Harlow Shapley learned of the death of his father, who was struck by lightning on the family homestead. In 1914 there were two big events in the life of Harlow Shapley. The year before, his fiancée Martha Betz had come east from Missouri to study teutonic philology at Bryn Mawr. She and Harlow were married on April 15, 1914. At about the same time, Frederick Seares, Harlow's former professor at Missouri, arranged to have him meet George Ellery Hale, then the Director of Mount Wilson Observatory. As a result of this meeting, Harlow Shapley was offered a position as a Junior Astronomer at Mount Wilson Observatory.

To prepare himself for the great research opportunities that lay ahead, Harlow Shapley paid a visit to Harvard College Observatory, where he was made to feel welcome by the famous director Edward C. Pickering, by the great woman astronomer Annie J. Cannon, and by Solon Irving Bailey. Conversations with Bailey led Shapley to undertake the study of globular star clusters, which became his principal concern at Mount Wilson.

Harlow Shapley's encounter with Solon Bailey had tremendous consequences. Bailey had concentrated on researches of variable stars in globular star clusters, with his most significant work having been done at Harvard Observatory's Boyden Station, in Peru. Shapley loved to tell how Bailey advised him in simple and compelling terms to undertake the study of variable stars in globular clusters with the aid of the fine telescopes of Mount Wilson Observatory, especially through the use of the 60" Reflector. Shapley followed Bailey's advice, and the rest is history. It seems now perfectly natural that, back in 1914, someone would have undertaken the study of variable stars in globular clusters, especially RR Lyrae variable stars with periods in the range mostly between half a day and one day. Through the

work of Ejnar Hertzsprung and of Henrietta Leavitt, it had become clear that these stars all had about the same median intrinsic brightness. Hence they could be expected to be perfect standard candles for obtaining information about the distances to the globular clusters in which they are observed. To Harlow Shapley goes everlasting credit for having had the good sense to have taken full advantage of the wonderful observational opportunities presented to him for the study of these stars.

The story of how Harlow Shapley undertook the study of variable stars in globular clusters, which led him to the discovery of the center of our Milky Way system, has been told a good many times. I have written at length on this subject in the chapter "Harlow Shapley and the Discovery of the Center of our Galaxy" in *The Heritage of Copernicus*, published in 1974 by the MIT Press on behalf of the National Academy of Sciences. When Shapley began his work at Mount Wilson Observatory, there was no good information about properties of the variable stars in globular clusters, and no reliable distances to the globular clusters were known. Using the estimated median absolute brightnesses of the RR Lyrae variables as a basis, Shapley managed to determine approximate distances to the globular clusters. These objects he found to be distributed in a large spheroidal system, with our sun occupying an obviously eccentric position. Shapley took the courageous step of identifying the center of the system of globular clusters with the center of our own Milky Way system. Since he could determine the distance from our sun to the center of the system of globular clusters, he had by inference obtained the distance from the sun to the center of the Milky Way system.

Shapley did for the Milky Way system what Copernicus had done for the solar system: He placed our sun and earth in the outskirts of the Milky Way system. He proved conclusively that our sun and earth are definitely not located close to the center of our galaxy.



The research assignment that Harlow (and Martha) Shapley undertook at Mount Wilson Observatory was far from a simple one. There were hundreds of photographs of globular clusters to be taken, which were used for the discovery of new short-period variable stars. A careful measurement of the apparent brightness of every variable star on a photograph had to be performed, and the period of light variation and median apparent magnitude for every star of interest had to be determined with care. Shapley did not have available calibrated median absolute luminosities for the stars in which he was interested. The difficult task of calibration had to be undertaken before the material could be used to reveal the grand picture that lay back of it all. In 1918 Shapley published the most important of the many articles that resulted from his four years of hard work at Mount Wilson Observatory, a paper entitled "Remarks on the Arrangement of the Sidereal Universe." In it, he shows that our sun is located near the outer edge of a vast Milky Way system. He estimated the distance from the sun to the center of that system to be 17,000 parsecs, 1 parsec equaling 3.26 light years. By present-day standards, this represents an overestimate by roughly a factor of two. Shapley can hardly be blamed for having overestimated the distance, for he, as everybody else at the time, was not aware of the presence of a general interstellar absorption of light close to the central plane of our Milky Way system.

I wish that every scientist could have a chance to read the Shapley papers in the *Mount Wilson Contributions*. They make for remarkably easy reading. Every one of them is simple and straightforward, and the papers can be read with ease by any student in a beginning course on astronomy, including those without any knowledge of calculus or of modern physics. Shapley established the RR Lyrae variables as the basic standard candles for exploration of our galaxy, and they continue to hold this place of honor right up to the present time.

Shapley's views about the eccentric position of our sun with

respect to the center of our galaxy were accepted by the astronomical world with little or no opposition. The outline that Shapley had drawn seemed to fit really much better into our overall view of the Milky Way system than did the picture that had been given to us by earlier astronomers. Northern Hemisphere astronomers only had to travel to the Southern Hemisphere and take a good look at the Milky Way in Sagittarius and Scorpius to realize that in that section lies the direction towards the greatest star agglomerations.

However, Shapley's values for the median intrinsic brightnesses and estimated distances for the RR Lyrae variables and the globular clusters were not accepted without challenge. His results seemed to indicate that the median absolute brightness of a typical RR Lyrae variable star equals 80–100 times the intrinsic brightness of our sun. Many astronomers doubted the validity of this conclusion, and there were several who advocated median intrinsic brightnesses one-tenth or less of Shapley's values. A fierce debate ensued. George Ellery Hale, then the Director of Mount Wilson Observatory, who was also deeply involved in the affairs of the National Academy of Sciences and of the National Research Council, decided in 1919 that the time had come for Harlow Shapley to give a lecture at the Academy about his new views on the Milky Way system and the universe. He suggested that members should hear at the same time a lecture by one of his strongest opponents, Heber D. Curtis, who was then on the staff of Lick Observatory, in California. The famous pair of lectures, now often referred to as the "Great Debate," was scheduled for April 26, 1920, at the time of the Annual Meeting of the Academy, in Washington, D.C. It must have been a grand affair! The texts of the two lectures, polished and changed considerably from the oral versions, were published in Bulletin No. 11 of the National Research Council under the title "The Scale of the Universe." This event, which was momentous in the annals of modern science, dealt with the

distance scale of the universe, *not*—and this is to be noted—with the position of our sun and earth relative to the center of the Milky Way system. *Heritage of Copernicus* tells the story of the Great Debate. Shapley defended strongly his distance scale to the globular clusters, which was basically fixed by the RR Lyrae variables found in these clusters. Curtis favored much reduced distances for these stars, based on intrinsically very much fainter absolute brightnesses. Shapley clearly came out the winner in the first part of the debate; however, there was a second side. Shapley and Curtis each discussed their views on the places that the spiral nebulae and ellipsoidal nebulae had in their pictures of the universe. Shapley considered these objects as relatively minor satellites to the Milky Way system, whereas Curtis viewed them as island universes in their own right. Curtis clearly won the second phase of the debate, for it is now of course known (since the days of Edwin P. Hubble) that the spiral nebulae and the ellipsoidal nebulae are truly galaxies in their own right, comparable in size and mass and often exceeding the Milky Way system.

One should not underestimate the lasting effect of Shapley's work on the use of cepheid and cluster-type variable stars for estimating remote distances on later studies of the universe. Ejnar Hertzsprung was probably the first astronomer with the vision to have seen the potential value of variable star studies in exploring the depths of the universe. However, it was Shapley's work that really laid the foundation for Edwin P. Hubble's work on distance estimates for spiral galaxies. In an obituary of Harlow Shapley that appeared in the January 1973 issue of *Physics Today*, Leo Goldberg notes specifically that Hubble "used precisely the same techniques for measuring the distances of galaxies that Shapley had invented to determine the distances of globular clusters."

We should refer briefly to one other aspect of Harlow Shapley's work—his hobby of the study of ants. During his years of

nighttime observing on top of Mount Wilson, he often spent time during the days to study ants. He established that ants of a certain variety moved with speeds that were markedly dependent upon the temperature. They ran much faster in the early afternoon than they did in the morning or towards evening. Their speeds appeared to be a function only of temperature, unaffected by humidity, barometric pressure, or season of the year. The study of ants was Shapley's principal hobby, and it helped to establish a lifelong friendship between him and William Morton Wheeler at Harvard, the nation's leading ant specialist. The bibliography to this memoir contains several papers on ants.

The Great Debate had one important fringe benefit: Among those present in the audience were George Russell Agassiz and Theodore Lyman, both friends of President A. Lawrence Lowell of Harvard University. They had been asked to have a look at Harlow Shapley as a possible successor to E. C. Pickering as Director of Harvard College Observatory. They both advised strongly in favor of the Shapley appointment, an action that had only mixed approval from the side of Henry Norris Russell (see the revealing summary of events described by Owen Gingerich in the *Bulletin of the American Academy of Arts and Sciences* for April 1973). In 1921, after a brief interim period, Shapley became the Director of Harvard College Observatory, a post that he held until 1952.

The 1920s and 1930s were the best years of the Directorship of Harlow Shapley at Harvard. Shapley's researches ranged far and wide. A new development was that he and his associates concentrated on studies of variable stars in the southern star clouds of Magellan. His researches during these years have been beautifully summarized in five articles honoring his eightieth birthday. The articles appeared in the *Publications of the Astronomical Society of the Pacific* for October and December 1965. During this period Shapley wrote several books, including the

delightful volume *Flights from Chaos* and a Harvard Observatory Monograph, *Star Clusters*. He had numerous very effective and distinguished collaborators: Among them were Helen Sawyer Hogg, Adelaide Ames, Henrietta Swope, Jenka Mohr, Constance Boyd, and Virginia McKibben Nail. During these years of great activity, Shapley published dozens of papers, including a magnificent "Catalogue of the Brighter Galaxies," prepared jointly with Adelaide Ames. He made extensive searches and studies of variable stars in Milky Way fields. He became—as he liked to be remembered—the cosmographer of the Magellanic Clouds, and he undertook a major survey of the distribution of faint galaxies in the Southern Hemisphere. He made most effective use of the dozen or so relatively small telescopes at Harvard Observatory. In his work he stressed especially the use of photographs made with the telescopes at Harvard's southern Boyden Station; until 1925 the Boyden Station was in Arequipa, Peru, and after that near Bloemfontein, in the Orange Free State of South Africa. His major discovery of the 1930s was the recognition of two dwarf galaxies: one in the constellation of Sculptor, the other in the southern constellation of Fornax. They were the first of the real dwarf galaxies to be recognized. These dwarf galaxies are now known to be a main constituent of the universe of galaxies. He especially encouraged Annie J. Cannon and her associate Margaret W. Mayall to complete the famous Henry Draper catalogue of stellar spectra and its various extensions; even today the Henry Draper catalogue and extensions figure prominently in the studies of our Milky Way system. Cecilia Payne Gaposchkin and her husband, Sergei, made massive and important contributions to the studies of variable stars during those years.

Not only did Shapley do good work himself during the 1920s and 1930s, but he brought to Harvard College Observatory many astronomers who gave distinction to the astronomical work carried out at Harvard. Astronomers, young and old, came from

all parts of the world to work with Harlow Shapley and his associates. Shapley also directed the building up at Harvard of one of the major graduate schools in astronomy. Those of us who were with Harlow Shapley during the 1930s were fortunate in collaborating in major ventures of astronomical development. We were given every opportunity to experiment and contribute to astronomical knowledge. The 1920s and 1930s were indeed good days for astronomy at Harvard.

Shapley has summarized his contributions to astronomy at Harvard Observatory in the Annual Report to the President and Fellows of Harvard University for the year ending September 30, 1952, the year of his retirement as Director of Harvard Observatory. This Report has been reproduced in part in the obituary of Harlow Shapley that appeared in *Sky and Telescope*, vol. 44, December 1972, and it deserves reading by all future biographers. After describing the development of the observatory since 1921, Shapley selects for special mention two activities that were very close to his heart: the work and the training of graduate students and international cooperation in various fields of astronomy.

We should comment briefly on the efforts of Shapley to establish graduate work in astronomy at Harvard University. During the Directorships of Shapley's predecessors, there were no offerings of graduate courses and no doctorate program was in effect. Undergraduate courses were given to relatively few students in a building far from Harvard College Observatory by people who were principally experts in celestial navigation. Shapley, initially ably assisted by Harry H. Plaskett (who lives now in retirement in Oxford, England), established a Harvard Graduate Program in Astronomy. Dozens of astronomers in the United States and abroad, including several members of the National Academy of Sciences, were trained for the Ph.D. at Harvard. The late Director of the David Dunlap Observatory of the University of Toronto, Frank S. Hogg, was the first to receive a Harvard Ph.D. in astronomy (1929).

During the 1930s, Harvard Observatory became a major research center. In addition to regular colloquia, Shapley created his famous Hollow Square Conferences. These were brief (ten minutes or so) reports by staff and graduate students, some dealing with research projects and others telling about major new results from many sources. Visitors from the United States and overseas participated actively in these Hollow Squares.

Harlow and Martha Shapley—and their family—occupied the fine old residence on the observatory grounds. They were very hospitable people. Every student could count on being invited to three or four big parties each year, and there were numerous special occasions. The Shapley Christmas parties were glorious affairs.

Shapley's international activities brought many astronomers from all over the world to Harvard Observatory for one or more years of research work. In the beginning, his selection was based entirely on scientific considerations. As the turbulent years in Germany and elsewhere came about in the late 1930s, Shapley became the guardian angel for many who looked for escape from totalitarian regimes. These were the years when Harlow Shapley the humanitarian came to the fore. As an example, I may quote the case of Richard Prager, the famous variable star observer of Berlin Observatory. He was Jewish and had to leave Germany in the middle 1930s. He told me quietly and seriously that every night at least a thousand Jewish scientists were saying a prayer of thanks for Harlow Shapley's humanitarian efforts, which had helped to save them and their families.

Harlow Shapley was one of the original backers of the American Association of Scientific Workers, an organization mostly of young people formed in the late 1930s. One of the activities in which he participated was a series of articles for a book, *Science from Shipboard*, for which he served as Senior Editor. It was published by Science Service in Washington, D.C., reissued later by the Red Cross under the title *What To Do Aboard a Transport*. Several hundred thousand copies of the little paper-

back book were read by service men and women during World War II.

Honors were beginning to come Shapley's way in abundance. He was elected to membership in the National Academy of Sciences in 1924. He became the recipient of many overseas and U.S. medals, and his distinguished lecture assignments became more and more frequent. He was a foreign member of many overseas academies and was extremely active in many international organizations, notably in the International Astronomical Union. He was honored with the Presidencies of many societies, including the American Association for the Advancement of Science, the American Astronomical Society, the American Academy of Arts and Sciences, and Sigma Xi. He was active on the Boards of Directors of many foundations and other organizations, including the Woods Hole Oceanographic Institution, Science Service, Massachusetts Institute of Technology, and the Worcester Foundation for Experimental Biology.

Following World War II, Shapley turned increasingly away from astronomical endeavors; national and international affairs claimed him. Looking back at it all, it seems a pity that about 1946 he did not resign his post as Director of Harvard Observatory to assume an important administrative scientific post in the national or international realm. After World War II, Harvard Observatory began to lose the leading position that it had reached in astronomy during the 1930s. This was in part due to the fact that so much of Shapley's time was dedicated to national and international affairs. These, Shapley felt, had higher priority than research and writing.

One of Harlow Shapley's proudest achievements during the late 1940s was the part that he played in the formation of UNESCO. He was a most effective member of the various national delegations to the international conventions that led to the formation of this very important United Nations' organization. He helped shape its present continuing program of activities.



Shapley subscribed firmly to the Preamble of UNESCO, in which it is said that "Since wars begin in the minds of men, it is in the minds of men that the defenses of peace must be constructed." Shapley truly became a citizen of the world.

The Nazi persecution during the 1930s and the horrors of World War II had greatly affected Harlow Shapley's attitude toward war. He became a strong and convincing fighter for world peace at all levels. This brought him many new friendships, some happy and others not so happy. In his comments on world affairs, Shapley showed the same independence of thinking and approach that had brought him fame during his studies that led to the discovery of the center of our galaxy. He spoke out on many issues without considering too much the views of others. This meant that on some issues he was obviously with the majority and riding high, but on others he was the spokesman for opposition. He held views honestly and independently that were considered dangerous and even subversive during the late 1940s and early 1950s. Shapley's activities during that period have been beautifully and adequately described by his friends and admirers, notably by Kirtley F. Mather in the summer 1971 issue (vol. 40) of *The American Scholar*, by Hudson Hoagland in the December 1964 issue of *The Publications of the Astronomical Society of the Pacific*, and by Don K. Price in the *Bulletin of the American Academy of Arts and Sciences* for April 1973.

During the late 1940s and early 1950s, Shapley's liberal attitude brought about many successes and many conflicts. For several years he was the President of the National Council of the Arts, Sciences and Professions, an organization that helped raise money to support liberal candidates for election to Congress. He helped organize peace rallies in New York and elsewhere. He became the personal friend and advisor of many highly placed people in the realm of national and international politics. These included Henry Wallace and Jawaharlal Nehru;

Shapley had good personal contacts with two Presidents of the United States, Franklin D. Roosevelt and Harry S Truman. He did many highly constructive things, such as lobbying for the establishment of the National Science Foundation; and, through his efforts with the Science Clubs of America, he brought many young people into science. Congressional conservatives generally took a dim view of Harlow Shapley's activities, and he was made the subject of nasty and difficult investigations by several congressional committees, including the infamous McCarthy committee. Senator Joseph McCarthy listed Shapley as one of the Communists in the State Department! He came out of these encounters shaken but undaunted and more than ever convinced that it was his job to stand out from the crowd and speak up when he thought that things were going the wrong way. He was a dissident in the tradition of many great Americans who had come before him. These were not easy days for Harlow Shapley and neither were they for Martha Betz Shapley. It caused the Shapleys much sorrow that some colleagues turned against Harlow Shapley.

I shall not easily forget the day when Shapley returned to Harvard Observatory after having been interrogated by Congressman John E. Rankin in Washington. He said with his voice breaking: "That man had the nerve to tell me that I am un-American." The liberal Harlow Shapley was a difficult man to handle when appearing before these committees. He was obviously dedicated to the pursuit of peace at all levels, and he was also most clearly not a Communist. He thus became a symbol for much that is good and impulsive in the great scientists of America.

Life became more relaxed and pleasant for Harlow and Martha Shapley after his retirement as Director from Harvard College Observatory and after he bowed out of national and international politics. Shapley was a very happy and continually active man during the 1960s; he lectured far and wide, especially

to young people. He was one of the initial lecturers in the Visiting Professors Program of the American Astronomical Society. This Program is now in part endowed by a fund known as the Harlow Shapley–American Astronomical Society Memorial Fund. He loved especially to go to small colleges without astronomy programs and to minority colleges. There are now many scientists of distinction in the United States who are indebted to Harlow Shapley for having given them their first real view of the wonders of modern science. Many people in all walks of life were touched by his colorful and thoughtful, always intellectually independent, lecture presentations and writings.

Shapley was a confirmed agnostic. However, for several years he participated actively in Rabbi Louis Finkelstein's Conference on Science, Philosophy and Religion, held at the Jewish Theological Seminary in New York. He became also very active in the Institute on Religion in an Age of Science. He edited a book, *Science Ponders Religion*, and throughout his writings he shows that he was thoroughly aware of possible spiritual factors in the universe. One of the degrees which he was proudest to have received was a Doctor of Divinity (1969) from the Meadville–Lombard Theological School, affiliated with the University of Chicago.

Toward the end of his very active life, Shapley was persuaded to provide the basic material for a volume of informal reminiscences entitled *Through Rugged Ways to the Stars*. It is not the very best of autobiographies, but it does show the true Harlow Shapley with all his wonderful ideals, his vanity, his compassion, and his greatness.

Harlow Shapley died on October 20, 1972, in Boulder, Colorado. Martha Betz Shapley is surviving her husband; she is now in her middle eighties. The Shapley tribe of children and grandchildren is a vast one. Mildred Shapley Matthews is an editor and research assistant at the Lunar and Planetary Laboratory of the University of Arizona in Tucson, Arizona. Her oldest

child, June Matthews, is a professor in nuclear and particle physics at MIT. Willis Harlow Shapley is the oldest of the Shapley's four sons. He is Associate Deputy Administrator at the National Aeronautics and Space Administration, in Washington, D.C. His daughter, Debora, reports on scientific matters in the weekly journal *Science*. Alan Horace Shapley has been for many years an active scientific administrator with a national and international reputation. He is now Director of the National Geophysical and Solar Terrestrial Data Center of the National Oceanic and Atmospheric Administration in Boulder, Colorado, and Washington, D.C. Dr. Lloyd Stowell Shapley is a senior mathematician and economist with the Rand Corporation in Santa Monica, California; he specializes in the mathematical theory of games. It would have given his father great pleasure to learn that Lloyd is a member of the American Academy of Arts and Sciences. The youngest son, Carl Betz Shapley, is the founder and director of the Shapley School International, a college preparatory school in Florence, Italy.

During the final twenty-five years of Harlow's life, he and Martha made their home in Sharon, New Hampshire. He is buried in the local cemetery at Sharon in a grave marked by a solid granite rock (from the grounds of the Shapley farm) that carries the inscription—"And We by His Triumph Are Lifted Level with the Skies"—a quotation from Lucretius. Historians of the future should not only take note of Harlow Shapley's great scientific achievements, but I hope that they will also remember him as a fine human being, as an independent, bold human spirit with a healthy distrust of all authority. Harlow Shapley loved to push beyond frontiers, scientific and human. He thought of our world as one large place, with unnatural national boundaries, populated by hundreds of millions of basically kind and worthy people. He was a great American who will be remembered for centuries to come. His name deserves to be carved in the marble walls of the National Academy of Sciences. He was the Copernicus of the first half of the twentieth century.

I ACKNOWLEDGE assistance in the preparation of this memoir from members of the Shapley family, notably from Mildred Shapley Matthews of Tucson. She undertook full responsibility for the preparation of the bibliography. In this work Mrs. Matthews profited greatly from an independent effort by the late T. C. Brooks of Harvard College Observatory. The entire manuscript was read with great care by Martha Betz Shapley, who contributed valuable historical background information.

I also wish to acknowledge assistance received from many colleagues, notably Drs. Owen Gingerich, Leo Goldberg, and Kirtley F. Mather, and from the then Home Secretary of the National Academy of Sciences, Allen V. Astin. The present text incorporates numerous suggestions made by the above people, all of whom read a first draft of the memoir and presented their comments and suggestions. Attention is drawn to the article in *Dictionary of Scientific Biography* (1975) by Owen Gingerich; it deals extensively with Shapley's publications and articles about Shapley, written by friends and colleagues.

## BIBLIOGRAPHY

*Prepared by Mildred Shapley Matthews*

## KEY TO ABBREVIATIONS

- Am. Sch. = American Scholar  
 Am. Sci. = American Scientist  
 Ann. Harv. Coll. Obs. = Annals of the Harvard College Observatory  
 Astron. J. = Astronomical Journal  
 Astron. Nach. = Astronomische Nachrichten  
 Astrophys. J. = Astrophysical Journal  
 Harv. Alumni Bull. = Harvard Alumni Bulletin  
 Harv. Coll. Obs. Bull. = Harvard College Observatory Bulletin  
 Harv. Coll. Obs. Circ. = Harvard College Observatory Circular  
 Harv. Coll. Obs. Monogr. = Harvard College Observatory Monograph  
 Irish Astron. J. = Irish Astronomical Journal  
 J. Franklin Inst. = Journal of the Franklin Institute  
 Laws Obs. Bull. = Laws Observatory Bulletin  
 Mon. Not. R. Astron. Soc. = Monthly Notices of the Royal Astronomical Society  
 Mt. Wilson Contrib. = Mount Wilson Contributions  
 Pop. Astron. = Popular Astronomy  
 Proc. Am. Acad. Arts Sci. = Proceedings of the American Academy of Arts and Sciences  
 Proc. Am. Philos. Soc. = Proceedings of the American Philosophical Society  
 Proc. Natl. Acad. Sci. USA = Proceedings of the National Academy of Sciences of the United States of America  
 Publ. Am. Astron. Soc. = Publications of the American Astronomical Society  
 Publ. Astron. Soc. Pac. = Publications of the Astronomical Society of the Pacific  
 Rus. Astr. Kal. = Russian Astronomicheskii Kalendar  
 Sci. Dig. = Science Digest  
 Sci. News Lett. = Science News Letter  
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