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JOSEPH HAINES MOORE

1878—1949

A Biographical Memoir by WILLIAM H. WRIGHT

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Biographical Memoir

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BY WILLIAM H. WRIGHT

J OSEPH HAINES MOORE came to the Lick Observatory in 1903. He was retired from active service a few months before his death, which occurred on March 15, 1949. For the greater part of his life he devoted a singularly lucid and inquiring mind to the service of the University of California and the Lick Observatory.

Moore was born in Wilmington, Ohio, on September 7, 1878, the only child of John Haines Moore and Mary Ann Haines. His parents were members of the Society of Friends, with long lines of Quaker ancestry, and Joseph was raised in the wholesome discipline of that sect; in youth and manhood he held to its philosophy of conduct, and he maintained his relations with the Society throughout his life.

Following his elementary education Moore attended Wilmington College. He took the classical course, and received the A.B. degree in 1897. While his studies there did not especially fit him for the career of scientific research to which he devoted his later years, he came, happily, in his senior year, under the inspiring influence of Professor N. E. Bennett, an enthusiastic teacher of astronomy, from whom he acquired the deep and lasting interest in that subject, and in the broad field of science, which characterized him during the remainder of his life.

The immediate consequence of Moore's collegiate experience was that he entered Johns Hopkins University with the purpose of studying astronomy under Simon Newcomb, then the most eminent astronomer in this country. At the university, however, he found his preparation for advanced study in science to have been inadequate, and it was necessary for him to take two years of undergraduate work to qualify himself for advanced status. At Johns Hopkins he received instruction by Newcomb in astronomy, and by Rowland, Ames, and R. W. Wood in physics. He majored in the latter field and received the Ph. D. degree in 1903. He came at once to Mount Hamilton and entered upon his career as an astronomer.

The field that claimed Moore's interest and attachment is that broad area of the astronomical domain which has to do with the measurement, by means of the spectroscope, of the rate of approach or recession of a heavenly body. These movements, which are customarily called "radial velocities," have in recent years played a capital part in the development of astronomical knowledge, as will presently be explained. The observations are made with a photographic spectroscope, or "spectrograph," as the apparatus is commonly termed, through the employment of the Doppler-Fizeau principle. The radial velocity of a star is derived from the measurements of lines in the star's spectrum, and is commonly expressed in kilometers per second. The Doppler-Fizeau principle is of so elementary a character, and is so generally understood, that it will hardly be necessary to explain it here. The strategic value of that principle to astronomy is not so well known, and a few words on this aspect of the subject may not be out of place. Observations of radial velocity provide, in general, the only means by which the linear dimension is brought into stellar astronomy. Observation with astronomical measuring devices other than the spectroscope provide, in the vast majority of cases, only angular positions and motions of the heavenly bodies, and these cannot, by themselves, complete the conception of the geometry of the stellar system. Radial velocities, being expressed in ordinary standards of length and time, have in many instances supplied the scale factor and have carried astronomers toward the solution of many of the great problems of their science. In this way dimension has been given to the universe of

stars, the distances of stellar groups have been determined, and the internal movements of many of the celestial bodies have been measured. There are few divisions of astronomy that are free from dependence upon observations of radial velocity.

On coming to the Lick Observatory, Moore joined H. D. Curtis as assistant to W. W. Campbell in the measurement of radial velocities of stars. Dr. Campbell had, a few years before, initiated a large undertaking in that field, but in the meantime had been appointed director of the observatory in succession to James E. Keeler, on the latter's death. To the normal duties of the directorship Campbell added a very considerable one by organizing an expedition to Santiago, Chile, for the purpose of measuring the velocities of stars that are not visible from the mid-latitudes of the northern hemisphere. The press of administrative duty made it necessary for him to provide separately for the conduct of the South American expedition and to assign the greater part of the spectroscopic work at home to Curtis and Moore. Three years later Curtis was detailed to take charge of the southern station, and Moore's responsibilities at home broadened. In 1909 he in turn relieved Curtis in charge at Santiago, and remained there until 1913, when he returned to Mount Hamilton. Thereafter, until 1945 he resided continuously at the Lick Observatory, except as his presence was required upon expeditions having as their purpose the observation of solar eclipses. In 1936 he became assistant director of the Lick Observatory, and in 1942 was appointed director. Beginning in 1944 he suffered some distress occasioned by the altitude of the Lick Observatory, and on November 30, 1945, following the advice of his physician, he relinquished the office of director and was transferred to Berkeley. There he gave instruction in the University and engaged in research until his retirement on September 6, 1948. While in Berkeley he apparently enjoyed normal health, but on the morning of March 15, 1949, he died in his sleep. Moore was active to the last day of his life. He left two uncompleted papers, which appeared posthumously.

Moore early became an outstanding contributor of information

relating to stellar radial velocities. The work was of a pioneer character. The strategic position of radial velocities in the general astronomical scheme was beginning to be realized, and the environment was one in which the interests of a young scientist might be expected to expand. An industrious and skillful observer, he provided, in the course of time, thousands of measurements of stars for such use as he or other astronomers might care to make of them. He further served his profession by gathering together the scattered results of observers the world over, and publishing them in homogeneous catalogues. At that time the demand of astronomy was for knowledge of the radial velocities of any and all stars, and the pressing problem was to supply this information to the profession as rapidly as possible. In view of the excellence of the implementation of the Lick Observatory for radial velocity measurement, the task of supplying this observational material, in as great volume and good quality as possible, was undertaken there. Under these conditions the observing naturally took on a routine character, with little color. There was always present the temptation, sometimes indulged, to take up the study of particular stellar systems, and thus lend variety to one's research, but, especially in the early days, the urgent call for radial velocities to meet the requirements of the general astronomical community had perhaps a narrowing influence. In a sense the Lick Observatory astronomers were providing bricks and mortar for the "glittering structures" of other builders.

As has been indicated, what has come to be called "the radial velocity program of the Lick Observatory" was undertaken in 1896. Its execution absorbed a large part of the resources of the observatory, and the efforts of its staff, for forty or more years. While Moore was not among the earlier participants in the work, his association with it was, in the long run, closer and of greater duration than that of anyone save Campbell, a circumstance that is recognized in the joint authorship, or indication of collaboration, under which the more important reports were published. The most comprehensive of these is the paper entitled: "Radial Velocities of Stars Brighter

than Visual Magnitude 5.51 as Determined at Mount Hamilton and Santiago." Radial velocities of all stars measured at the two stations, up to January 1, 1927, 2771 in number, are contained in this paper, which is accompanied by a full discussion of the observations and a redetermination of the elements of the solar motion. The report has aptly been described as the most extensive and homogeneous body of information relative to the radial velocities of stars that has yet appeared. It covers the first twenty-five years of Moore's association with the observatory, and records, in its introduction, the expression of Director Campbell's appreciation of the services of both Dr. and Mrs. Moore.

At this point the introduction of an item of personal history seems appropriate. On June 12, 1907, Dr. Moore was married to Miss Fredrica Chase, of Payette, Idaho. Miss Chase, a graduate of Vassar College, had come to the Lick Observatory as an astronomical assistant in 1905. Their association was an ideal one and brought happiness to the observatory community as well as to themselves. Mrs. Moore rendered much technical aid to her husband throughout their married life, and especially during their residence in Chile in the conduct of the D. O. Mills Expedition to the Southern Hemisphere. It is a pleasure to quote Dr. Campbell's citation of their work.

"Dr. J. H. Moore joined the staff of the Lick Observatory in the summer of 1903, and, continuously from that date, nearly the whole of his time has been devoted to the determination of stellar radial velocities, as published in this volume, and of nebular radial velocities, as published in LO, 13, 75-183, 1918, and in preparing the observed stellar velocity data for publication. He was Astronomer in Charge of the D. O. Mills Expedition to Chile during the more than four years covering its third period, and the large number and fine quality of the spectrograms secured in that period speak well for the skill and energy of his administration. Before and after his period of service in Chile he secured . . . 2422 spectrograms at Mount Hamilton for the determination of stellar radial velocities, and his measures of spectrograms were numerous. Mr. Moore as-

sumed general charge of the programs of radial velocity determinations at Mount Hamilton and Santiago on July 1, 1923, when Director Campbell became President of the University of California. . . . The tabular matter in this volume has been prepared entirely under the supervision of Mr. Moore, and the solutions for the elements of the solar motion were conducted by him. The painstaking and laborious reading of the proof sheets for this volume has also been done by Mr. Moore, with the assistance of Mrs. Moore and a few other members of the Lick Observatory staff.—W.W.C.

"The devoted and able services rendered by Mrs. Moore to the cause of stellar radial velocity determination, not only during the four years when she was an assistant on the staff of the D. O. Mills Expedition in Chile, with principal duty the measurement and reduction of spectrograms, but in the past two years as an experienced assistant in the preparation of the manuscript for this volume, and the extensive proofreading therefor, is gratefully acknowledged. —W.W.C."

Within the field of radial velocity measurement Moore's interest was especially directed toward the discovery and observation of spectroscopic binary stars. Broadly speaking, and for the purposes of this note, these objects may be described as double stars that are so close together that they cannot be separated by a telescope, but which are shown to be composite by periodic variations of velocity within the system, as measured with the spectroscope.

The simplest case is presented by a bright star that has a relatively faint orbital companion, too faint to contribute sensibly to the total light received from the pair. The light available for analysis is, in effect, that which comes from the brighter star, and since that star moves periodically toward and away from the observer according to the laws of gravitational mechanics, some of the orbital elements of the system can readily be calculated. In other cases the spectra of both components are observable, and reciprocal motion is detected; this adds further to knowledge of the system. There are indeed instances where more than two stars are involved in a system,

and special treatments are usually necessary in the reduction of these. In some instances it appears that variation in radial velocity is not to be interpreted as an indication of actual duplicity or multiplicity, of a star, but as the consequence of variable motion within the star's atmosphere, which is, after all, the element of the system whose velocity is measured. By way of illustrating these considerations reference may be made to the case of Polaris, the north star, which has been found, through its variable radial velocity, to consist of a bright star accompanied by a dark one, which revolve about their common center of mass in a period, as determined by Moore, of approximately 29.6 years. The bright star shows, in addition, a short period variation in radial velocity of 3.97 days, which is now believed to be due to disturbance within the star's atmosphere. It will thus be seen that the study of spectroscopic binaries provides a powerful and elastic method of stellar observation, calling for judgment and discrimination in its interpretation. It is a field that owes much to the skill and industry of Moore. He discovered 64 spectroscopic binaries, 30 of which were detected in cooperation with Dr. George F. Paddock of the Lick Observatory. His interest in these matters is reflected by the third, fourth, and fifth catalogues of binary stars, and it is appropriate to mention here the extensive General Catalogue of Radial Velocities of Stars, Nebulae and Clusters. Of these several papers the third was authored jointly with Dr. J. F. Neubauer.

The foregoing are works of reference the value of which can hardly be overestimated. They make available to astronomers, at sight, material collected from scores of sources. It is likely that Moore derived as much satisfaction from the arduous labor of compiling these catalogues as he did from the preparation for publication of his own researches, for the reason that, as a social being, he liked to be useful to his fellow man.

Moore's capabilities and interests were not limited by the boundaries of a specialty; he was concerned with every aspect of the profession of astronomy. He was a member of five expeditions dispatched by the Lick Observatory to various spots on the earth to observe total eclipses of the sun, and was in charge of two of them. His fields of investigation on those occasions related to the Einstein gravitational effect upon light, to movements within the corona, to the coronal spectrum and to related matters. The circumstances of Moore's work brought him into contact with problems of a widely varied character, in the development of which he actively participated, and which in turn contributed to the breadth of his scientific outlook.

"To astronomers in many lands Joseph Moore is known as the source of a great amount of dependable information that they require in their own researches. His colleagues remember him as an able and resourceful observer, and, above all, as a warm and loyal friend. Perhaps the students and younger members of the staff found themselves more in his debt than any of the other participants in the community life. These young people came to him for advice on likely subjects for research, and he gave unstintingly of ideas that he might have used to his own professional advantage had he not been burdened with routine work. Through suggestion, guidance and actual physical help, he set students upon careers that have brought credit to the University of California and to the Lick Observatory." (From *In Memorium*, 1949, The University of California.)

Dr. Moore was a member of the principal learned societies within the fields of his interest; among them the following: Royal Astronomical Society of London (Fellow); International Astronomical Union; American Association for the Advancement of Science (Vice President, Section of Astronomy, 1932); American Astronomical Society; American Physical Society; Astronomical Society of the Pacific (President, 1920, 1928); California Academy of Sciences (Fellow); Royal Astronomical Society of New Zealand (Honorary Member); National Academy of Sciences.

Dr. Moore is survived by his wife and two daughters, Mary Kathryn (Mrs. H. Verne Gates), and Margaret Elizabeth (Mrs. Vinton S. Matthews). There are six grandchildren.

KEY TO ABBREVIATIONS

Astroph. Jr. = Astrophysical Journal Contr. L.O. = Contributions of Lick Observatory L.O. Bull. = Lick Observatory Bulletin Pub. A.S.P. = Publications of the Astronomical Society of the Pacific Pub. L.O. = Publications of the Lick Observatory Proc. Nat. Acad. = Proceedings of the National Academy of Sciences Sci. = Science

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