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ALFRED HARRISON JOY

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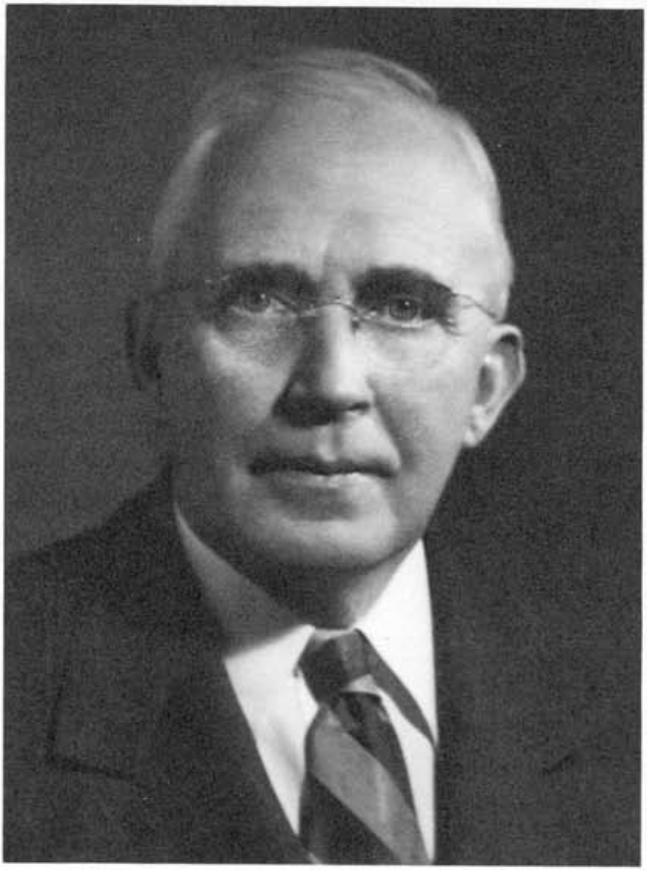
A Biographical Memoir by

O. C. WILSON

Biographical Memoir



Alfred H. Jay

ALFRED HARRISON JOY

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BY O. C. WILSON

THE MOUNT WILSON OBSERVATORY was founded in 1904 by George Ellery Hale who at that time succeeded in enlisting the support of the Carnegie Institution of Washington. The completion of the 60-inch telescope in 1908 marked the beginning of a lengthy period of pre-eminence in stellar spectroscopy, which was further enhanced when the 100-inch telescope began operation in 1918. This era lasted roughly until mid-century when the completion of other large, more modern, telescopes and technological advances provided serious competition.

During the period noted above a considerable part of the success of the Mount Wilson Observatory was, of course, due to its excellent equipment and its advantageous location. But at least an equal part must be credited to the able, enthusiastic, staff of stellar spectroscopists who were responsible for the proper use of its facilities. This group, of whom Alfred Joy was the last survivor, included Walter S. Adams, P. W. Merrill, R. F. Sanford, M. L. Humason, and G. Stromberg. In varying degrees these men contributed enormously to virtually all areas of stellar spectroscopy and, as a glance at the appended bibliography will testify, Joy was at the forefront of productivity.

Alfred H. Joy was born in Greenville, Illinois, and was educated locally, obtaining the degree of Ph.B. from Green-

ville College in 1903. He then moved to Oberlin and studied physics for a year, receiving an M.A. in 1904. His career then deviated considerably from that of most professional researchers since, after leaving Oberlin, he became a teacher in 1904 at the Syrian Protestant College in Beirut (now the American University of Beirut) where he remained, with the exception of one year, through 1914. The year of 1910–1911 he spent as a Thaw Fellow studying astronomy at Princeton under H. N. Russell. His interest in astronomy had been stimulated by working at the observatory at Beirut and by being a member of the Lick Observatory Eclipse Expedition to Aswan, Egypt, in 1905. Joy's enthusiasm for astronomy led him to be a volunteer summer assistant at Oxford and Cambridge in 1909, at Yerkes Observatory in 1910 and 1911, and at Potsdam Astrophysical Observatory in 1914. In this way he acquired a variety of practical experience, met many of the leading astronomers of the time, and filled in some of the gaps in his astronomical education.

In 1914 Joy returned to Yerkes Observatory to spend a year as an instructor and to take part in several research programs. He had planned to return to Beirut in 1915 but, since this was rendered difficult by World War I, he accepted an offer by George E. Hale to come to the Mount Wilson Observatory as an assistant in solar researches being carried on by Hale and Charles E. St. John, and he continued this work for three years. During this period, in 1916, because of his interest in stellar distances, he became associated with Walter S. Adams in a study of spectroscopic parallaxes of stars. This was a method that had recently been worked out by Adams and A. Kohlschütter to determine absolute magnitudes of stars by noting the relative intensities of certain absorption lines in their spectra. Thus it was not until the age of thirty-four that Joy finally began work in the field that was to occupy him for the remainder of his active life, and upon which his well-deserved reputation was to rest.

At this time stellar spectroscopy was still in its early stages. The Henry Draper Catalogue (published 1918–1924), which provided spectral classifications of well over 200,000 stars derived from objective prism spectrograms, was still in preparation. But the study of stars with slit spectrographs, which would provide radial velocities and detailed information of many kinds, had been hampered by the relatively small telescopes, slow spectrographs, and relatively slow photographic emulsions then available. In fact, very little information of this kind had been obtained for stars much below fifth magnitude in apparent brightness. The installation of the large Mount Wilson reflectors, together with improved spectrographs and photographic plates, now began to open up for exploration a vast region of fainter objects containing a great variety of fascinating stars of widely divergent properties. Joy and the other members of the spectroscopic group at Mount Wilson lost no time in taking advantage of these opportunities.

The spectroscopic absolute magnitude program mentioned above, and the routine collection of stellar radial velocities (these could both be found from the same spectrograms), were group undertakings involving several staff members, including Joy, and extended over many years. But numerous other investigations were carried on simultaneously, especially spectroscopic studies of many types of variable stars that had hitherto been mostly inaccessible. Several of the staff also participated in these investigations, though not in the same way as for the large "observatory" programs. To a considerable degree, Joy, Merrill, and Sanford divided up the general variable star field, although there was some overlap, and a number of joint papers were published. Merrill did most of the work on the long period M-type variables, while Sanford tended to specialize on those of spectral types R and N. This left an extensive list for Joy: Cepheids, novae, irregular variables, flare stars, the brighter variables in globular clusters, and those variables named for their prototypes, U Geminorum, T Tauri, RR Lyrae, W Vir-

ginis, and RV Tauri. I do not know how this division of labor among the variable stars came about, but in practice it seemed to work very satisfactorily. In fact, the Mount Wilson spectroscopic group was outstanding, in my opinion, for a feeling of mutual respect, good fellowship, and cooperation and for a total lack of the jealousies, frictions, and internal bickerings that blot the records of so many research organizations. To this smooth and pleasant operation Joy's own personality automatically made him a major contributor.

Joy's extensive bibliography has already been mentioned. A great many of the items in it are brief notes recording an interesting fact concerning the spectrum of a single star or of a group of stars. Others give more or less extensive lists of stellar radial velocities or spectroscopic parallaxes. Still others relate to the derivation of the orbits of spectroscopic binaries or to lists of spectroscopic binaries newly discovered at Mount Wilson. Much of this work originated in the large observatory observing programs previously mentioned. But while this work was in progress Joy was also busy collecting information on a wide variety of variable stars. A great many of these objects were quite faint and the collection of the necessary information consumed a number of years of often difficult and trying observation. As a consequence, most of Joy's major papers were not published until the decade preceding his retirement and during a period of several years thereafter. In the following paragraphs I shall try to give the highlights of Joy's major contributions to astronomy; for convenience, they are arranged in order of the absolute magnitudes of the various objects, beginning with the intrinsically brightest.

Joy published several notes and papers on the spectra of novae. Perhaps the most interesting of these was the recurrent nova RS Ophiuchi, which had outbursts in 1933 and 1958. This object is noteworthy for the appearance in its spectrum of forbidden lines of very highly ionized atoms such as [Fe XIV],

[Ca XV], [Ca XIII], and [A XIV], of which Joy measured and identified a considerable number.

Over many years Joy collected spectrographic observations of nearly 160 Cepheid variables. These stars are intrinsically bright, have small individual motions, and are, therefore, well suited to studies of galactic rotation. Joy used his radial velocities to derive the parameters of galactic rotation, getting good agreement at the time (1938) with other current determinations. Since then new and improved values of the parameters have been derived, although Joy's radial velocities remain of great value. They were used, unchanged, in the extensive work of R. P. Kraft and M. Schmidt (1963) in which improved knowledge of the absolute magnitudes of Cepheids and better photometry enabled these authors to make a step forward.

Another group of intrinsically bright stars whose spectra show superficial similarities to those of the Cepheids are the semiregular variables of RV Tauri type, and similar objects that do not fit accurately the RV Tauri criteria. Joy made a spectroscopic study of thirty-eight of these stars. He found that they could be separated into two groups of low and high velocity, a division supported by certain spectroscopic features. Although these stars appear to have luminosities similar to those of the Cepheids, there are decided kinematic and spectroscopic differences. Even today, the proper relationship of these stars to other variable or nonvariable objects does not appear to be certain.

In connection with his studies of the intrinsically bright variable stars, Joy obtained spectrograms of W Vir as early as 1925 that showed that this type of Cepheid differed in spectral behavior from the standard ones as well as having different spatial distribution in the galaxy. He found that W Vir showed hydrogen emission on the rise to maximum and that its radial velocity was larger than is usual for Cepheids. This was an anticipation of the general division of stars into populations I

and II proposed much later by W. Baade. Pursuing this matter further, Joy obtained spectrograms of a number of variables in globular clusters. He found that these objects are virtually all W Vir-type Cepheids, or RV Tauri and semiregular variables, and that classical Cepheids and Mira stars are essentially absent from the clusters. Of particular interest was his study of Barnard's variable in M3, which proved to be similar to W Vir. Joy also made studies of a considerable number of RR Lyrae variables, determining their radial velocities and showing them to be a high velocity group, also a member of Population II.

As mentioned previously, P. W. Merrill was the specialist in long period M-type variables. Joy did some important work in this field, however, especially on Mira itself, first in a study of the peculiar close, early type, companion of Mira, and, later, an extensive investigation of the spectrum of the variable, some of it done at the highest available dispersion of 2.3 Å/mm. This work revealed many detailed differences between the lines of various elements during a cycle and even some differences between lines of the same multiplets. One of the most significant results was that Joy was able to identify most of the absorption features that appear in the strong hydrogen emission lines as due to metallic or molecular lines, thus demonstrating that the region where the hydrogen emission is produced lies below that responsible for the normal absorption line spectrum.

To this point we have dealt with Joy's work on intrinsically bright variables. But there were many others, known or surmised to be intrinsically faint, which Joy studied with his customary intelligence and thoroughness, and for which he uncovered much hitherto unknown information.

One such group is that named for its prototype T Tauri. Joy made a spectroscopic study of a number of these objects and found numerous strong emission lines of hydrogen and metals in their spectra. The hydrogen lines are several angstroms in width, vary in an irregular manner, as is also true

of the overall brightness of the stars, and are displaced toward the violet, indicating ejection of matter. The absorption lines are characteristic of a spectral type near G5 and yield absolute magnitudes close to those of corresponding normal main sequence stars. Joy showed also that these variables are associated with the dark absorbing clouds of the Milky Way and that some are involved in faint reflection nebulosity. More recent work by G. H. Herbig and others indicates that the T Tauri stars are probably very young and in the process of settling into a stable state on the main sequence.

Joy worked also on a number of spectroscopic binaries, some of which have proved to be of outstanding interest. One of these was RW Tauri, whose components are of spectral types B9 and Ko, the latter probably a subgiant. As the eclipse of the B9 star progressed, Joy found that the hydrogen lines showed first a widely red displaced emission component, then no emission at all near the center of eclipse, and lastly a widely violet displaced emission component. These observations indicate that the B9 star is surrounded by a rapidly rotating ring of matter in which the emission lines are produced. The eclipse of this ring by the K-type star explains the spectroscopic phenomena.

Two other important binaries investigated by Joy are the U Geminorum stars SS Cygni and AE Aquarii. His observations showed that the late type components are main sequence stars while their companions are peculiar hot B-type subdwarfs. The periods are short: 0.27 d for SS Cygni and 0.70 d for AE Aquarii. These systems are noteworthy for occasional outbursts of light that originate in the hot companions. Later investigation by R. P. Kraft has shown that all U Geminorum stars are short period binaries of this kind.

Over many years Joy maintained a great interest in the dwarf M-type stars that populate the faint end of the main sequence. He produced a number of lists of such stars with spectral classifications and estimates of H and K emission

strengths. He was particularly concerned with the stars in this region that show sudden increases in brightness from time to time, the so-called flare stars. He was fortunate to obtain spectrograms of one of them, UV Ceti, during flares, and found that the hydrogen emission lines widen and strengthen, and that a strong continuum appears, which extends into the violet and tends to veil the absorption spectrum. It is believed that these flares are analogous to the well-known solar flares, and in recent years radio emission has been observed from some of these objects during flaring.

Alfred Joy was secretary of the Mount Wilson Observatory from 1920 until his retirement in 1948 and thus had a number of administrative chores in addition to his research. He served as president of the Astronomical Society of the Pacific several times and as president of the American Astronomical Society in 1950–1952. For many years he edited the Astronomical Society of the Pacific leaflets, which provided both professionals and amateurs with short authoritative expositions of current astronomical research. In 1944 he was elected to the National Academy of Sciences and in 1945 was awarded an honorary Sc.D. by Greenville College. He was the recipient in 1950 of the Bruce Medal of the Astronomical Society of the Pacific in recognition of his outstanding achievements.

Joy was married in 1919 to Margherita O. Burns and is survived by her, by two children, Richard and Edith, and by several grandchildren.

Alfred Joy was always a kind, considerate, and helpful colleague. He was fortunate, both as to time and place, in having a great opportunity in his chosen field, and his skill and intelligence enabled him to make excellent use of it. I think it is no exaggeration to say that all who knew him regarded both the man and his work with the greatest admiration and respect.

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KEY TO ABBREVIATIONS

Astron. J. = Astronomical Journal
Astron. Soc. Pac. Leafl. = Astronomical Society of the Pacific Leaflet
Astrophys. J. = Astrophysical Journal
Pop. Astron. = Popular Astronomy
Proc. Natl. Acad. Sci. = Proceedings of the National Academy of Sciences
Publ. Am. Astron. Soc. = Publications of the American Astronomical Society
Publ. Astron. Soc. Pac. = Publications of the Astronomical Society of the Pacific

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