Some Reminiscences of the Yerkes Observatory, 1898–1904

Walter S. Adams
Director Emeritus, Mount Wilson Observatory

THE PERIOD OF 50 YEARS WHICH HAS elapsed since the dedication of the Yerkes Observatory has been one of transformation in much of the field of astronomy. It opened at a time when visual observations with telescopes were still a major factor in observatory activities, photographic methods were in their infancy, the spectrum was studied empirically, and cosmogony was almost a completely sealed book. The period ends with visual observations greatly reduced in amount, although still holding an important place, with photographic methods applied almost universally and enormously improved and extended, with the spectrum analyzed and used as an extraordinarily powerful tool to seek out physical processes in the sun and stars, and with a clear and logical picture of a physical universe beyond the imagination of the astronomer of 50 years ago.

The Yerkes Observatory has taken a notable part in these great developments. It was fortunate in having as its founder and first director a man of remarkable insight and initiative, with a clear understanding of the major problems of astronomy and an almost intuitive perception of the fields of investigation which would yield the greatest returns. Although primarily a solar physicist, George Hale always emphasized the place of the sun among the stars and the necessity for applying to the stars the knowledge derived from their nearest representative. So, we find during his years of directorship not only marked advances in the methods and instruments used for the study of the sun, but also developments in stellar research which have proved remarkably fruitful in later years. He was one of the first to recognize the possibilities of the reflecting telescope, then a much neglected instrument in the United States, for both direct photography and spectroscopy, and secured from his father the gift to the Observatory of the 60-inch mirror which was later used in the first large reflecting telescope on Mount Wilson. Hale also made a great advance in the application of powerful spectrographs to the photography of both solar and stellar spectra. Realizing that spectrographs attached to moving telescopes must necessarily be limited in size and length, he developed the coelostat and concave mirror into a standard type of telescope for solar observations, and planned the use of the coudé focus of large reflecting telescopes for corresponding investigations of stellar spectra.

In other fields Hale's contribution was equally important. He appreciated at once the advantages of photography with a long-focus telescope for measurements of stellar parallaxes and brought Schlesinger to the Observatory to use the methods he had developed in this fundamental but difficult branch of positional astronomy. He encouraged Ritchey to undertake photography through yellow color filters at the 40-inch telescope, a project which resulted in some of the finest photographs of the moon, star clusters, and brighter nebulae ever obtained. The 24-inch reflecting telescope was also built at this time, and in Ritchey's hands began, in friendly rivalry with the Crossley reflector of the Lick Observatory, to penetrate into the domain of the more distant nebulae. The fundamental work in stellar radial velocities, under the immediate direction of Edwin Frost, was supported strongly by Hale, and benefited greatly from his advice and optical and instrumental skill and knowledge. He also established a department of stellar photometry, in which Parkhurst carried on a long series of measurements of magnitudes of variable stars, and invited E. F. Nichols to attempt the radiometric investigation which resulted in the first successful measurement of the heat radiated by a star. Finally, Hale, who was a physicist at heart, carried out in the laboratory, either by himself or with collaborators, several spectroscopic investigations designed to imitate or help to explain phenomena observed in the sun and stars. The maintenance of such an intimate relationship between telescope and laboratory instruments operated under controlled conditions was a cardinal principle in Hale's scientific career.

It is clear from this brief summary that Hale had solved in a most efficient way the difficult problem of utilizing a large, existing telescope to the best advantage. In later years he was able to reverse the situation to a considerable extent, building instruments to fit the problems in mind, and his experience at the Yerkes Observatory then proved of the utmost value. We can readily understand, then, why Hale's colleague, Frost, could have given to the 40-inch refractor the title of "the busiest great telescope in the world." Used for solar observations during the day and for a wide variety of stellar investigations by night, the 40-inch telescope could well have carried above the entrance to its dome the sign on the doors of numerous Chicago saloons of those unregenerate days: "We have thrown away our keys. Open all the time."

My relationship to the Yerkes Observatory began in 1898 when, on the advice of Frost, who had been my teacher in astronomy at Dartmouth College, I undertook

graduate study at the University of Chicago and spent some months at the Observatory in acquiring practical observing experience on the sun under Hale and in stellar spectroscopy under Frost. Soon afterward I went to Germany for study at the University of Munich, but after about a year the offer by Hale of a position as assistant at the Observatory led to my return in the early summer of 1901. I remained until May 1904, when Hale organized the first expedition to Mount Wilson.

The Yerkes Observatory was dedicated in October 1897, so that, when I first knew it as a student the following year, recollections of the occasion were fresh in the minds of everyone. These have been supplemented by an interesting book of records and clippings collected by Frederick Seares, who was present as a delegate from the University of California. This book, through his kindness, is now in the library of the Mount Wilson Observatory.

The dedicatory exercises occupied five days, the first three of which were devoted to meetings, addresses, and demonstrations of instruments and apparatus, primarily for the benefit of the visiting astronomers and other scientists. On the fourth day special trains left Chicago for Williams Bay, bearing Mr. Yerkes, President Harper, and the Trustees of the University, together with many city officials and other prominent citizens. The formal presentation of the Observatory and its acceptance were made on this day. The trains returned to Chicago late in the afternoon in time for an evening dinner tendered the visiting scientists by Mr. Yerkes, at which President Harper served as toastmaster. On the fifth and last day the buildings and laboratories of the University were inspected, the exercises closing with a reception to Mr. and Mrs. Yerkes and the delegates in attendance.

No one can look back upon this dedication without realizing how strong and genuine was the interest of the citizens of Chicago in this great gift to science. Some 800 persons attended the final exercises at Williams Bay, and all the Chicago newspapers carried long and detailed accounts of the day-by-day proceedings. They had good reason to feel that the new observatory was peculiarly their own. It was given by a Chicago man to a Chicago institution, and the man who was responsible for its establishment and was its first director was born and lived in Chicago. Naturally, the newspapers were not inclined to conceal these facts, nor did they fail to issue headlines which sound remarkably familiar even now. "Great Eye to Open," "Great Lens Focused," and "Feast of Wise Men" were some of the expressions which may well serve again at the dedication of the 200-inch telescope. Although the principal feature of the 40-inch telescope was correctly named on this occasion, astronomers know, to their sorrow, that it takes more than half a century to convince the average reporter of the difference between a lens and a mirror.

The chief interest in such an event consists in the men who were present, and numbered among them were nearly all those whose names were so familiar in astronomy at the beginning of the century: Hale, the man of 29, who had seen the first of his great dreams come true; Simon Newcomb, the rather grim dean of American astronomers; Keeler, whose brilliant career was so soon to close; Pickering of Harvard, with his diversified astronomical interests; two of America's distinguished physicists, Michelson and Henry Crew; Runge, the German spectroscopist; and the group of famous visual observers which included Barnard, Burnham, Comstock, Doolittle, and Ormond Stone. With such a variety from which to choose, the reporter, with his eternal desire for "human interest," had a field day, for the element of picturesqueness was by no means lacking. In particular he preyed upon Burnham, the great double-star observer, to whom Newcomb, in the course of his lecture, had paid a special tribute for his remarkable discoveries with small telescopes. Under the headline, "Burnham Is in Focus," the reporter pictured the unconventional Burnham on the stage at Newcomb's lecture as "a little man who wore neither gown nor cap, but dropped into his place, slid down to about the middle of his back, and folded his arms. . . . His face was thin and his hair seemed bent on going where the wind listeth (*sic*)." At Newcomb's reference to him the reporter said that "the little man seemed to slide down another inch in his chair and pull his arms into a tighter fold." As I came to know Burnham shortly afterward, the description seemed to me a fairly accurate one, with the possible exception of the last statement. At that stage in the lecture there is a strong probability that Burnham was asleep.

It was an interesting and highly individualistic staff that was gathered together at the Observatory in these early years. The vivid personality of Hale, with his eagerness and enthusiasm and a mind constantly searching for new methods and devices, was balanced by the more deliberate Frost, whose conservative judgment was the heritage from a long line of New England ancestors. Together they formed a most efficient combination, with Hale usually the originator of a plan and Frost the counselor and critic. This difference in outlook almost invariably assured a well-considered decision which had been judged from many points of view.

Barnard and Burnham were great figures in the field of visual astronomy, to which the science has been indebted for many of its most spectacular discoveries. Each was a master of that difficult instrument, the filar micrometer, but their temperaments were very different. Although a most active observer, Burnham was philosophical in his outlook: if a night was stormy or the seeing was impossibly bad, Burnham took the matter calmly; there was always a good book to read, or someone to talk to, or even a game of whist to play if sufficient players were available. Barnard, on the other hand, felt a sense of injury and would be in the depths of despair

if the night was bad, or, conversely, would be on the top of the world after a clear night with good seeing. Barnard's absorption in his work was almost incredible. On a stormy night he would often go out into the rain every few minutes to observe the direction of the wind and the amount of rainfall in the hope of being able to predict a clearing. On clear nights he would be in the dome long before dark, observing some bright star or planet or glancing impatiently into the field of the telescope until his object became visible. He had many of the simple and lovable characteristics of a child, and it was a deep pleasure to me in later years to renew at Mount Wilson the warm friendship begun at the Yerkes Observatory.

The two other members of the staff with whom I was chiefly associated at this time were Ellerman and Ritchey. Ellerman had been an assistant to Hale for several years at the Kenwood Observatory and was a remarkably skillful and resourceful observer. His long experience with instruments made him invaluable in the adjustment and testing of the experimental apparatus which preceded the construction of more permanent equipment such as the Rumford spectroheliograph. He was an excellent photographer, highly competent with machine tools, and always ready to help visiting scientists who came to the Observatory for special investigations, or inexperienced students or assistants like myself, who were trying to gain some knowledge of observational astronomy. Ellerman had many outside interests such as music, tennis, golf, and swimming, and his attempts to stalk a wild goose with a rifle over the ice in the middle of Lake Geneva were a regular feature of the winter season.

Ritchey was a perfectionist in his methods of work and had a tendency to surround his optical figuring and his observing with a somewhat unnecessary atmosphere of secrecy and even awe. Nevertheless, his results were in general proportional to the care which he took. Several of his superb mirrors, together with the photographs which he made with the Yerkes Observatory instruments and in later years at Mount Wilson, bear witness to his skill and form a contribution of great and permanent value.

Without entering upon any detailed description of the work of the Observatory during these early years it may be of interest to comment briefly upon some of the more important investigations then in progress. Hale's primary interest was naturally in the spectroheliograph, which he had invented only a few years previously. His chief object was to explore the possibilities of this instrument in solar research, and with this in view he designed, after considerable experimentation, the Rumford spectroheliograph. As used on the 40-inch telescope, it proved remarkably efficient, enabling him not only to study the distribution of gases of various elements in the solar atmosphere through the use of their corresponding spectral lines, but also, in the case of calcium, to explore the distribution in depth by using different portions of the same line. The need of greater dispersion to exploit fully exacting observations of this kind led Hale to plan the coelostat type of fixed telescope with which spectroscopic instruments of any desired focal length could be used. There can be little doubt that the excellent photographs made with the Rumford spectroheliograph showed some traces of the vortical structure around sunspots, the full recognition of which at Mount Wilson led Hale to his remarkable discovery of the magnetic field of spots.

Solar spectroscopy, although necessarily limited by the length of the spectroscopes which could be attached to the large refractor, was also carried on successfully. The fine solar seeing often found at the Observatory, especially during the autumn months, led to the detection of the green carbon fluting in emission at the edge of the sun, and many other bright chromospheric lines were observed and listed. The lack of sufficiently powerful spectrographs, and the absence during these years of large sunspots because of the phase of the spot cycle, were responsible for the limit on the number of observations in this rich field of study.

In stellar spectroscopy chief emphasis was laid upon measurements of radial velocity, although the important investigation of Secchi's fourth type stars by Hale, Ellerman, and Parkhurst dealt largely with the physical aspects of their spectra. Considerable attention was devoted to the spectrum of Nova Persei, the brilliant nova of February 1901. It is interesting to realize that the large telescopes of the world are still obtaining important data on this nova nearly 50 years after its outburst. Frost wisely selected for intensive observation of radial velocity the relatively neglected class of B-type, or helium, stars. The lines in the spectra of these stars are usually diffuse, and several photographs were needed to provide a reasonably accurate value of the velocity. As a result, the number of stars observed increased but slowly. A discussion of the radial velocities of 20 such stars, published by Frost and Adams in 1903, showed clearly, however, that the average motion of these stars is exceptionally small, a conclusion which has proved important in later discussions of stellar motions. Numerous spectroscopic binaries were discovered in the course of these observations.

The micrometric observations of Barnard during these years ranged over a wide field, from measurements of the diameters of the major and some of the minor planets to the enormous labor involved in the triangulation of many stars in globular star clusters. The extraordinary accuracy of these visual measurements has always been a source of wonder to astronomers, and he was well named "Barnard of the wonderful eyes." His determinations, for example, of the parallax of 61 Cygni and of the positions of Eros compare favorably with the best photographic results. My most interesting experience with Barnard's observing occurred on one fine summer night when I looked in at the dome of the 40-inch telescope and found him measuring the position of the fifth satellite of Jupiter, which he had discovered at the Lick Observatory some years

earlier. This is a difficult object because of the glare of the great planet, and many astronomers have never even seen it, but Barnard was measuring it steadily as it moved outward toward elongation and then turned back again. Time was valuable, and I volunteered to record his measures so that he would not have to remove his eye from the eyepiece more often than necessary. The figures slowly increased, became stationary, and then began to decrease. The following day Barnard showed me a curve on which the measured values fell almost as closely as if they had formed a part of the curve itself. The fact that Barnard, at the height of his observing powers, time and again observed the planet Mars under the best of conditions with telescopes of various apertures, and could never detect the very fine markings described by Lowell and a few others, would seem to provide the most conclusive evidence bearing on this vexed question.

Burnham was also an extraordinarily able visual observer but did not have Barnard's catholic interest in almost every object in the sky. He lived exclusively for double stars, and there is a tradition that one day he mentioned casually to Barnard having seen a comet in the field of one of his double stars on the preceding night, but he had not measured its position. The comet was a new one, and Barnard's horror can well be imagined. Burnham was an inveterate cigar smoker, and on the morning following a night's work a fairly accurate analysis of his observing schedule could be made from the intricate trail of tobacco ashes on the floor of the dome. On one occasion his smoking habits resulted in a fire in his office which partially burned the couch on which he was taking a nap. Burnham was a delightful companion, and on stormy nights two or three of our younger group would often gather in his office to listen to his stories or to play a game of whist, of which he was very fond. Mrs. Frost occasionally visited us to form a fourth player at the table.

Burnham's observing nights were always at week ends, since he served as a district court reporter in Chicago during the other days of the week. An unfailing sign of his coming, for which we used to watch eagerly, was the arrival at the Observatory of a case of Burgundy. Whether his taste for wine was acquired during his years in California, whether it was due to the fact that the water of Chicago at that time often had to be boiled, or whether it formed part of his general Bohemian instincts we never knew.

The pioneering work of Schlesinger in developing methods and placing on a firm foundation photographic determinations of stellar parallax, visual photometric observations of variable stars by Parkhurst, and various laboratory investigations, mainly spectroscopic in character, completed most of an active and productive program during these years. The radiometric measurements by Nichols of the heat radiation from Arcturus, Vega, and two of the planets, made in the summer of 1900, attracted much attention from scientists. It is interesting to note that these first results obtained in a difficult field show the marked difference in the amount of heat radiated by Arcturus and by Vega, two stars of nearly the same apparent magnitude. An amusing incident occurred during these observations. Charles St. John, then, I believe, on his first visit to the Observatory, was assisting Nichols in the adjustment and calibration of the radiometer, using for the purpose a candle flame in a field west of the instrument and about a quarter of a mile distant. Suddenly the vane of the radiometer rotated violently, and the spot of light used for measurement leaped completely off the recording scale. St. John had brought his beaming face into the path of light and had obtained a physical measure of his unfailing good nature.

The younger group at the Observatory during the last years of my stay included Philip Fox; Herbert Reese, later professor of physics at the University of Missouri; and Street, who assisted Ritchey in the optical shop. We were all of nearly the same age and lived at Mrs. Sawyer's house on the main road leading to Williams Bay. Miss Ware took her meals with us and had a most beneficial and civilizing influence upon a lively group, of which Fox was naturally the ringleader. R. James Wallace, known, of course, as "Hoot," and his family lived next door and was a close and always entertaining friend. Under such conditions and with the hospitality of the Frost, Barrett, Schlesinger, and Wallace houses available, we had the best of times together even in the comparative isolation of a small community in a Wisconsin winter.

As might be expected, the members of our group were usually engaged in trying to get the best of one another, and Fox was a master at the game. So Reese and I felt a grim satisfaction one Saturday evening in the fall of the year when Fox and Street, who had been absent all day, arrived at the house, limping, somewhat battered about the face, and extraordinarily uncommunicative. Some time before, we had been discussing the subject of football games between teams of rival high schools in southern Wisconsin, and Fox and Street, the athletes of our group, had announced that it would be most amusing and entertaining to join one of these teams and show its opponents how the game should be played. This was quite possible, since eligibility rules were unknown or remarkably elastic, to say the least. Reese and I had pretty much forgotten this conversation, but it seems that Fox and Street had selected this day and offered their services to a high school about 30 miles from Williams Bay. They were accepted without difficulty, but unfortunately the opposing team had gone them one better and negotiated with several husky mill hands in a neighboring steel factory. It took a long time to pry out of Fox the score of the game.

On another occasion Street was again a victim and Fox and I were the perpetrators, taking shameful advantage of Street's lack of knowledge of the constellations. One very cold winter night when Fox and I were at the Observatory a telegram arrived, announcing the discovery of

an 8th magnitude nova. We visited the dome, where we found Frost, I believe, considering the possibility of observing the star with the smallest spectrograph available. After some time we went home, awakened Street, and gave him the news, carefully omitting any reference to the star's brightness. Street was greatly excited and asked where it was, whereupon we pointed to the brilliant Procyon, riding high in the winter sky. "Gee," shouted Street, hurried on his clothes, and started for the Observatory along the path through the snow. Fox and I went to bed after safely locking our doors.

The lake and golf were naturally the chief centers of our outside interests at the Observatory. Once Fox and I made a trial swim on the day after the ice went out, but this experience was not repeated. Several of us tried to swim across the lake, but Fox was the only one to succeed, the coldness of the water discouraging those of lesser strength and endurance. The good ship *Argo*, a small sailing boat, was for some time the proud possession of Fox and Street, but not being expert sailors and having had to swim ashore a few times after capsizing in uncertain winds, they gradually lost interest in their venture and left to others the search for the Golden Fleece. The beauty of Lake Geneva in all its different aspects is one of my choicest memories of the years at the Observatory.

The golf course in its original form consisted of 6 holes laid out in the fields north and west of the great dome. There were no formal bunkers or traps, since the character of the course offered plenty of natural difficulties and hazards, consisting, as it did, of roughly mown hay fields with occasional bushes and thickets. The group with which I usually played included Hale, Frost, and Ellerman, and I remember our games together mainly because they brought out so clearly the individual characteristics of the players: Hale, with his eagerness and zest, making many fine strokes but occasionally "pressing" through overenthusiasm; Frost, deliberate and calm, stamping on the ground before a drive until he had settled his long frame into the most comfortable position; and Ellerman, who was normally our best player, studying his strokes with great care and usually executing them equally well. It was Ellerman who painted his golf balls red in order to play over the hard snow in winter, and who once amused himself by making a drive approximately half a mile long over the glare ice of Lake Geneva.

In assembling these scattered reminiscences of the early years of the Yerkes Observatory I have tried to give a picture, however slight and inadequate, of the individuals who made up the small group which started the Observatory upon its scientific career. The years were difficult ones financially, and auxiliary equipment was scanty and hard to obtain. Seen from the present point of view, a few of the problems investigated do not appear of the first importance; for physics, if not in the dark ages, was at least static, with the renaissance yet to come, and the means for interpreting the results of observation were still hidden from view. Nevertheless, the group of those years was an active one and had a leader of great vision and insight who prepared for what the future might bring; the able and highly trained staff of the present day, with greater instrumental resources and all the recent developments of modern science at its command, has shown brilliantly how great a structure may be erected upon the foundations laid half a century ago.