

# Historical Address upon the Dedication of Steward Observatory

April 23, 1923

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The present hour is the culmination of a long process in which ideas and hopes have been slowly changing into the reality which we dedicate this evening. It is a fitting time therefore to review briefly the history of this development, indicating thereby our gratitude to those who helped and encouraged.

The astronomical equipment of the University of Arizona began about 1891. In the first purchase of apparatus, Chancellor M.P. Freeman included a four-inch telescope which had belonged to the Chabot Observatory in Oakland. This excellent Brashear glass was mounted by Professor Boggs upon a cement pier on a spot north of the present Memorial Fountain. The instrument was used by him and by Professor G.E.P. Smith in that location. When the trees nearby grew too large, about 1904, the pier was transferred by Professor E.M. Blake to a point near the meteorological shelter, some fifty yards east of the Old Main, where it was used by Professor Medcraft in 1905 and by myself in 1906, 1907, and 1908. This instrument has now come to a place of permanent usefulness as finder on the big telescope where it can be recognized in spite of the coat of black paint which partly disguises it.

In 1908 while Science Hall was in process of construction, Professor E.C. Pickering, director of Harvard College Observatory, Cambridge, Massachusetts, offered to lend us an eight-inch telescope. Dr. Kendrick C. Babcock, then President of the University, approved the acceptance of this offer and authorized the construction of an observatory room on the top floor of Science Hall. He did not like the idea of a round dome in such a conspicuous place, and therefore the sliding roof was constructed which is familiar to so many.

This glass has had a past of its own. It had formed part of the old eight-inch meridian circle with which fundamental star positions were observed by Professor Bond and his colleagues at Harvard Observatory more than half a century ago. The lens of the circle itself and the lenses of the two meridian marks were made by the Clarks in the days of their best optical work. In 1908 Professor Pickering decided to dispense with that type of meridian mark and thus render available two eight-inch lenses, one of which he wished to mount in a telescope for atmospheric tests. Fortunately for us it seemed economical to him to make two mountings at the same time, just alike, instead of one. Therefore, Professor Bailey took one of these to South Africa for his atmospheric exploration and the other one was offered to us. The clock which has been a part of it for so many years is of very poor design, though very well constructed; the design was made by the writer, and the construction was done by Mr. Isaacson of our mechanical engineering department. This telescope was mounted in April, 1909 and remained in its place until it was dismantled last August to be returned, with gratitude, to the Harvard Observatory, who desired to see its philanthropic work continue in an observatory in Poland where there was need for such an instrument.

The instrument just described constituted an important contribution toward the Steward Observatory for it gave long and convincing evidence of the advantages of this location for astronomical work. Besides being used for classes from the spring of 1909 to the summer of 1922, it was used on the planet Mars during the favorable part of each opposition. One of its last bits of work was the observation of the great white area on Mars of July 9 and 10, 1922, which was so beautifully photographed at the Lowell Observatory. This instrument has been used many hundreds of hours on Jupiter's large satellites; it showed Comet A, 1910, to some two hundred people in one evening, who one and all rightly concluded that a telescope does not help much in looking at a comet. It showed the division in the nucleus of Halley's Comet in 1910. In one of those observing seasons, seventy-two nights out of seventy-five were found to be available for work. In 1911 a series of moon photographs demonstrated the possibility of work on thirty nights in succession. In the winter of 1913 and 1913 a series of forty nights in succession showed thirty-six workable and twenty-six of extremely fine character.

Perhaps it was this success on Mars at the worst time of year which started a more active campaign for a large instrument at this University. In the beginning of that campaign a number of good people gave their encouragement and help. Among them was Governor Hunt, who first expressed interest in this matter in 1908. The late Honorable John T. Hughes took great interest and would have given important service if his health had permitted. Dr. M.P. Freeman wrote strong letters to people who might be influenced. The newspapers gave valuable publicity, and many friends recognized the tribute to our climate which a large telescope would offer. So in 1914 the whole question of a large instrument was placed in a more compact and presentable form for the consideration of the new president, Dr. Von KleinSmid, who arrived here in September of that year. A picture was prepared showing by diagram the size of the telescope we have, a four-inch; the size of the telescope we borrowed, an eight-inch; and the size of a telescope we needed, a twenty-six inch. Quotations were compiled from letters received from the first astronomers in the country, Professor E.C. Pickering, Dr. George E. Hale, Professor W.W. Campbell (now recently elected President of the University of California) and a resolution was quoted from the American Astronomical Society, expressing its approval of the proposed new observatory and its location. Prices and estimates from various manufactures were obtained and a budget was included in this condensed proposal. But the legislature which met in the early part of 1915 failed to make the appropriation desired. President von KleinSmid thereupon used his good offices in an attempt to obtain by other means the items which the legislature had not provided. In this he was splendidly successful for in 1916 came the princely gift of sixty thousand dollars from Mrs. Lavinia Steward.

Mrs. Steward was a charming and lovely character, deeply interested in the arts and sciences. She had books on astronomy and a portable three-inch telescope through which she delighted to show the wonders of the heavens to her grand-nephew and nieces. She had planned to do something for the University and felt a personal inclination towards some astronomical equipment. Thus all conditions were happily favorable for the beginning of the Steward Observatory. Mrs. Steward passed away in August, 1917. It is my deep regret that she did not live to look through this magnificent instrument. The Steward family is represented here by Mr. and Mrs. Fred J. Steward, to whom and to whose descendants forever all the doors of this observatory are wide open.

A few months ago, Mrs. Fred Steward delighted my heart by handing to me the identical three-inch telescope which had so long been in the home of her aunt.

Now that the gift was made and the coming of an observatory was sure, a number of very interesting and agreeable duties fell to the writer, the first of which was the selection of a suitable site. Of course an attractive and important structure like the present one would have looked extremely well near the front of the campus, but certain tests made in 1915 had shown that the campus lights would be fatal. The use of the hills near the Desert Laboratory was considered, but such location would prove expensive in the matter of light and power and roads. Careful tests carried completely through many nights in 1916 showed that there was very little difference between the Desert Laboratory hill and a location on the campus. The use of a campus location was estimated to sacrifice about ten percent of atmospheric advantage on the hills. Accordingly the campus site was preferred, and the highest point on the campus has been occupied. Friends deride this advantage in height and say that the height of this highest point is invisible to the naked eye, but I hasten to assure everyone that it is probably twenty-five feet higher than the lowest part of the campus, nearly half a mile away. The real advantage in the present northeastern corner of the campus is in the control of lights, a feature most essential to the success of the Observatory. At the time this point was selected there were practically no houses nearby to the east or north, but after the long delay of the war this part of the city has grown rapidly. The city Council, however, has expressed the wish for most cordial cooperation with the Observatory in the matter of avoiding objectionable lights, of which the common arc light of the city street is the greatest offender.

A second labor of love was the selection of the type of telescope to be constructed and the determination of its details. The refracting telescope had been the efficient form for nearly a century, but Keeler at the Lick Observatory in 1900 had shown the great value of the reflector, and the details of its construction had been vastly improved at the Mount Wilson Solar Observatory. Extensive tests made with the great sixty-inch telescope on Mount Wilson, for many years the largest telescope in the world, had satisfied the writer that the reflecting type of telescope, though requiring a more elaborate technique in handling, could be as efficient as the refracting instrument and at the same time for the same money could provide an aperture some fifty percent greater in diameter. Accordingly this form of instrument was decided upon. The details were discussed with the best authorities- Dr. Hale, Mr. Pease, and Mr. Ritchey of the Mount Wilson Observatory; Fr. Frost, and Dr. Barnard of the Yerkes Observatory; with Professor Pickering of Harvard, with Warner and Swazey, manufacturers of Cleveland; with the much beloved Brashear of Pittsburgh, the famous optician; and with Mr. Lundin of the grand old firm of Alvan Clark and Sons, Cambridge, the firm which in its long history made all the large refracting telescopes in America. The contract for the mounting was signed with the Warner and Swazey Company of Cleveland, Ohio, in February, 1917, and then the war came and postponed all activity for two years. If there had been no war the Observatory would have been completed in 1918 or 1919.

On the resumption of work in 1919 plans were completed for the building by Lyman and Place, architects. A structure was especially designed to withstand changes in temperature. These architects deserve very great credit for its beauty and symmetry. About half of the cost of the building came from the University, and half from the original fund.

The dome is the design of Mr. Godfrey Sykes, of the Carnegie Botanical Laboratory, who had had previous experience in building domes for the Lowell Observatory in its early days.

In the latter part of the same year Messrs. Warner and Swazey resumed work on the plans of the telescope, and in 1920 the actual manufacturing was begun, with the completion finally accomplished in June, 1921. The instrument reached Tucson by the last of July and was mounted in place by Mr. Fickett of Tucson, and by Mr. Cook, a mechanical expert who had been sent on from Cleveland.

In 1919, also, work on the glass was seriously taken up with reference to its manufacture in this country, since none could be obtained from France, which had heretofore supplied all the large discs. The Spencer Lens Company of Buffalo, N. Y., having specially developed the making of optical glass during the war, undertook the production of a disc for us. For a year they tried their regular glass furnaces without success. In 1920 they installed a new electric furnace with complete automatic control, and after further failures they rebuilt in 1921 both gas and electric furnace and in October started a disc in each. These discs were in the furnace six weeks; when finally examined just before Christmas they proved to be splendid successes, and thus the first large telescope glasses ever made in America were produced.

The better of the two discs was selected and in February, 1922, sent by express to Pittsburgh for optical work to be done by J. B. McDowell, son-in-law and successor to John A. Brashear. The completed glass was received here on July 10, 1922, and mounted by the writer assisted by two former students, Mr. T. J. Randolph and Mr. L. R. Patterson. The first View through the new telescope was of a beautiful crescent of the planet Venus in the afternoon of July 17, 1922, Mr. Sykes, Mr. Normant and Mr. Randolph being present.

Thus we are provided with a thirty –six-inch reflecting telescope which embodies valuable features. It has a great range of focus, fifteen to one hundred ten feet, a superb curve on the mirror as shown by Hartman test, a clock of unusual perfection, having only a periodic error of one second of arc every four minutes, full electric control, and electric thermometers for taking care of temperature changes. The temperature coefficient of the glass is extremely small, and the building is not only beautiful to the eye but is arranged with great convenience and for maximum protection against heat changes between day and night. There are three much larger telescopes than this and some six or eight varying between this size and four inches larger; thus we are unusually well equipped for astronomical investigation.

Many people ask, "Is the Observatory finished?" I answer: "No, it is only just begun." It is only complete in the sense that is finally workable. A dedication like this symbolizes the completion of a material part. But a dedication is dual, in being part material and part spiritual. The material part is the building of brick and steel and glass which you see; the spiritual part is the living human force which enters this Observatory and makes it live. In this ceremony we dedicate ourselves to the perpetuation of this human force, which is nothing less than the soul residing in this physical structure. I want this Steward Observatory to live, and in living it must grow, and in growing it must produce results. Its use for classes is fine; its use for the public is fine; but it will not live without scientific results. That means we must have scientific men to keep it busy. From time to time, further equipment should

be added in order to enlarge human knowledge, and suitable publications must present to the world the knowledge acquired here.

In concluding I wish to leave with you a more general view. This installation is to be devoted to scientific research. Scientific research is business foresight on a large scale. It is knowledge obtained before it is needed. Knowledge is power, but we cannot tell which fact in the domain of knowledge is the one which is going to give the power, and we therefore develop the idea of knowledge for its own sake, confident that some one fact or training will pay for all the effort. This I believe is the essence of education wherever such education is not strictly vocational. The student learns many facts and has much training. He can only dimly see which fact and which training will be of eminent use to him, but some special part of his education will take root in him and grow and pay for all of the effort which he and his friends have put into it. So it is with the research institutions. In this Observatory I sincerely hope and expect that the boundaries of human knowledge will be advanced along astronomical lines. Astronomy was the first science developed by our primitive ancestors thousands of years ago because it measured time. Performing that same function, it has played a vast part in human history, and today it is telling us facts, forever wonderful, about the size of our universe; perhaps tomorrow it will give us practical help in showing us how to predict climatic conditions in the future.

Historically and practically, therefore, the work of this observatory is a line of research worthy of a rapidly growing State and University, of our fine climate, and our aggressive and intelligent people.