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OF

# EDWARD SINGLETON HOLDEN

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BY

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EDWARD SINGLETON HOLDEN, son of Edward and Sarah (Singleton) Holden, was born in St. Louis, Missouri, on November 5, 1846. His secondary education was received in private schools at Cambridge, Massachusetts, and during the years 1860-'62 in the Academy of Washington University, St. Louis. He was a student in Washington University during the years 1862-'66, receiving the degree of bachelor of science in the latter year. William Chauvenet, author of the well-known Manual of Spherical and Practical Astronomy, was professor of mathematics and astronomy in Washington University, and it is probable that Mr. Holden pursued astronomical studies more or less extensive with Professor Chauvenet. Professor Holden's later associates, who are now residing on Mount Hamilton, recall his frequent remark that his interest in astronomical subjects had been aroused on the occasions of visits to Harvard College Observatory while his cousin (by marriage), George P. Bond, was an observer and later (1859-'65) director of that institution. Mr. Holden was a member of Professor Chauvenet's household during a part of his student days, and married Chauvenet's daughter Mary in the year 1871.

Mr. Holden was a cadet in the U. S. Military Academy at West Point during the years 1866-'70. He was graduated in the latter year, with third rank in his class. During the academic year 1870-'71 he was second lieutenant in the Fourth U. S. Artillery. In 1871-'72 he was second lieutenant in the U. S. Corps of Engineers, serving as instructor in natural philosophy in the Military Academy. In 1872-'73 he was instructor in practical military engineering in the Academy. He published an octavo treatise on "The Bastion System of Fortifications, Its Defects and Their Remedies," in 1872. Mr. Holden resigned his commission in the army in March, 1873, to accept appointment as professor of mathematics in the U. S. Navy, for service as astronomer in the U. S. Naval Observa-

tory, Washington, D. C. Professor Holden was assigned to duty on April 15, 1873, as assistant with the transit circle, under Professor Harkness. The 26-inch refracting telescope of the Naval Observatory was completed in November, 1873, and on November 17 Professor Holden was transferred to that instrument as assistant under Professor Simon Newcomb. It is clear from historical developments, as well as from passages in Newcomb's "The Reminiscences of an Astronomer," that Newcomb was tremendously impressed with Holden's energy and ability. When Mr. D. O. Mills, president of James Lick's first board of trustees, went to Washington in 1874 to consult with Newcomb and others concerning plans for the Lick Observatory, Newcomb "suggested that a director of the new establishment should be chosen in advance of beginning active work, so that everything should be done under his supervision. As such director I suggested that very likely Professor Holden, then my assistant on the great equatorial, might be well qualified. * * * The necessity of choosing a director was not, however, evident, but communication was opened with Professor Holden as well as myself to an extent that I did not become aware of until long afterward."

It is an illuminating comment upon Professor Holden's promise as an astronomer of the future that he should be recommended, and probably tentatively selected, as the director of the proposed Lick Observatory, to contain the largest and most powerful telescope in existence, at a time when his astronomical experience had covered but little more than one year. Professor Holden was then less than twenty-eight years of age. The appointment referred to was not made, as the first board of trustees resigned in 1875, following certain unsatisfactory relations with James Lick, and a new board of entirely different personnel was appointed by Lick in 1876, under whose auspices the actual construction of the observatory was conducted. The appointment was actually made by the regents of the University of California on October 20, 1885, for service as director to begin upon the completion of the observatory, two or three years later.

Professor Holden continued as assistant with the 26-inch refractor under Professor Newcomb to May, 1875, and under

Professor Hall to February, 1880. In addition to assisting energetically with the principal programs of observation with this instrument, Holden undertook many pieces of work on his own account. He investigated the object glass and the micrometers of the great equatorial and published a brief description of the instrument. He observed the positions of the satellites of the planets; he observed especially interesting double stars; he made drawings of Mars, Jupiter, and Saturn, and of several especially interesting nebulæ; he observed the surface markings of the planet Venus; he made position observations of the comets; and he made extensive observations of the Great Nebula in Orion. His monograph on the Nebula of Orion, based upon observations begun in 1874 and continued through many years, is the most extensive paper on the subject that has ever been published. It includes a painstaking résumé of all previous observations, his own observations of the positions and brightness of the principal details of the nebular structure, and a comparison of his results with the earlier observations. Holden expressed the hope that his work would be useful to succeeding astronomers when examining the object for evidences of motion or of variations in brightness. Before the monograph was published Dr. Henry Draper had made the first photograph of the Nebula of Orion, in September, 1880, and a full-page artotype reproduction of Draper's photograph of March 14, 1882, exposure 137 minutes, was included in the monograph. Although the photographic method of delineating such objects was then in its infancy, Professor Holden recognized some of the advantages of this method over the visual method of observation. The sequel has, indeed, shown that searches for motion and other evidences of change in the Orion Nebula will be based upon the photographic records alone. This is one of the penalties which the pioneers pay to progress.

The transit of Mercury which occurred on May 6, 1878, was observed by Dr. Henry Draper and Professor Holden at Draper's observatory in New York.

Professor Holden was in charge of an expedition dispatched by the Naval Observatory to Central City, Colorado, to observe the total solar eclipse of July 29, 1878. His part in the observ-

ing program consisted of a search by visual methods for the hypothetical planet Vulcan. All objects seen were identified as well-known stars.

Professor Holden was sent to London in 1876 as a delegate from the United States Government to examine and report upon the South Kensington Loan Collection of Scientific Instruments, especially as to improvements in astronomical and geodetical instruments.

While on the staff of the Naval Observatory Professor Holden made himself very familiar with the literature of astronomy. He prepared and published a very complete bibliography of papers and books relating to nebulæ and star clusters, to the transits of Mercury, and to other subjects. He prepared annual reports on the progress of astronomy. He wrote many popular articles for the magazines and many semi-popular articles for scientific journals. In collaboration with Professor Newcomb, he wrote a text-book on astronomy for high schools and colleges. An abridged edition of the latter volume served for schools. He prepared and published (1881) a volume on "Sir William Herschel: His Life and Works"; and in collaboration with Professor C. S. Hastings he prepared and published (1881) "A Synopsis of the Scientific Writings of Sir William Herschel."

In February, 1879, Professor Holden was relieved in part from technical duty to serve as librarian of the U. S. Naval Observatory. For work of this kind Professor Holden possessed unique talents, and it is not surprising to read in the Superintendent's report, dated October 20, 1879, that the library "is now in a satisfactory condition." While engaged in cataloguing the library Professor Holden prepared a complete index to the publications of the Washington Observatory during its entire existence, from 1845 to 1875. He served as assistant on the transit circle under Professor Eastman from April 1, 1880, to January 1, 1881.

Professor Holden resigned the professorship of mathematics early in the year 1881 to accept appointment as director of the Washburn Observatory of the University of Wisconsin, in succession to Professor J. C. Watson, deceased. His activities at Madison are reflected in the publications of the Washburn

Observatory, volumes I to IV. They include observations of nebulæ, double stars, red stars, comets, etc.; meridian observations of star positions, especially of the 303 stars in Auwers's Fundamental Catalog of Southern Stars; of investigations on the distribution of stars in the sky, based upon Sir William Herschel's star gauges and the principal existing star charts. In collaboration with Prof. J. G. Hagen, he prepared and published a catalogue of 1,001 stars from the observations of Tacchini in Palermo in the years 1867-'69.

The National Academy of Sciences organized an expedition to observe the total solar eclipse of May 6, 1883, in the Caroline Islands. Appropriations in support of the expedition were made by Congress and from the Watson Fund of the National Academy. Professor Holden was appointed chief of the observing party and scientific director of the expedition. Associated with him were four young astronomers whose names later became well known: Professor C. S. Hastings, Mr. E. D. Preston, Mr. S. J. Brown, and Mr. Winslow Upton. The experiences passed through by many eclipse observers in the tropics fell to the lot of the expedition to the Caroline Islands; the sky was clear during the greater part, but not all of totality, and during the partial phases there were clouds and rain. The air in most tropical localities is so near the saturation point that the fall of temperature when the moon is covering the sun is sufficient to cause clouds and precipitation; and that the sky is clear one moment does not mean that the following minute will not bring clouds and the following five minutes rain. Professor Holden's expedition was successful in carrying out all of the main features of the program. A search for the hypothetical planet Vulcan led again to negative results. Spectroscopic and polariscopic observations of the corona were secured as planned. The details of the corona were observed visually. The times of contact were estimated and the influence of the eclipse upon the meteorological elements was observed. The memoir on the eclipse of 1883 is a model in form and is frequently referred to by past and future observers of eclipses.

Professor Holden's connection with the Lick Observatory, University of California, is perhaps the most interesting and

important factor of his life. We have referred to Professor Newcomb's recommendation of his assistant, Professor Holden, for the position of director of the Lick Observatory. Professor Holden served extensively, but for the most part informally, and at all times without remuneration, as a scientific adviser to the Lick trustees during the organizing and construction period. Professor Newcomb's counsel was sought and freely given during the same period. Professor Holden visited Mount Hamilton in 1881 to assist in the installation of the meridian circle and to observe the transit of Mercury. He also visited Mount Hamilton in the fall of 1883, on the return trip from the Caroline Islands. It was upon the advice of Professors Newcomb and Holden that the atmospheric conditions on Mount Hamilton were tested by Professor Burnham in the summer of 1879. The trustees had delayed action on this subject until after the county of Santa Clara had constructed an excellent stage road from the Santa Clara Valley to the summit of Mount Hamilton, in fulfillment of their definite agreement with James Lick. The location of the observatory was, therefore, impossible of change after the road was built, but fortunately Mr. Burnham's report upon the observing conditions was enthusiastically favorable.

Professor Holden was appointed president of the University of California and director of the Lick Observatory on October 20, 1885, to serve in the former capacity until the observatory should be completed and thereafter in the latter capacity. His active service as president began about January 1, 1886, and as director of the Lick Observatory on June 1, 1888. Between these dates his interest in and service for the observatory were constant and of great value.

An astronomer has well said that "the first requisite for the director of a great observatory is to have a very clear notion of just what kind of work ought to be done, how it should be done, and then to give all the aid in his power to the investigator." Director Holden selected the most promising men he could find in the United States to comprise the observatory staff, and great credit must be accorded to his acumen, judgment, and courage in appointing several young men upon the basis of their contributions, as yet very limited in number and

extent. He assigned the members of the staff definitely to certain lines of research, which the future has shown to be of the highest importance. He gave them such opportunities to succeed as no other astronomers had ever enjoyed. In particular he gave them great liberty of action, wished them success, and the results of their work were published over their own signatures. To quote from Newcomb's Reminiscences, page 190:

"The institution made its mark almost from the beginning. I know of no example in the world in which young men, most of whom were beginners, attained such success as did those whom Holden collected around him."

The evidences of Professor Holden's organizing ability and energy are written all over the Lick Observatory. Nor were these qualities confined narrowly to the internal work of the institution. The total solar eclipse of January 1, 1889, was effectively studied, on his initiative, by a well-equipped expedition from the Lick Observatory. The Astronomical Society of the Pacific is truly his creation. The Montgomery Library Fund of the society, the Donohoe Comet-Medal Fund and the Bruce Gold Medal Fund were provided at his solicitation. He devised the unique regulations governing the bestowal of the Bruce gold medal, which insure that the award made by the trustees of the society shall be of unquestioned wisdom. In maintaining the relations of this observatory with other similar institutions throughout the world and in making the more important results of the observatory's researches known to the scientific public, Professor Holden gave devoted and able effort.

His own scientific work in the Lick Observatory related principally to the photography of the moon. He encouraged the study of his lunar photographs by astronomers in other institutions, and he published a lunar atlas comprising nineteen large sheets, the reproductions of enlarged photographs. He made occasional observations of the nebulæ and of the planets. He was the editor of the Publications of the Lick Observatory, quarto, and of Contributions from the Lick Observatory, octavo. Three volumes of the former and five of the latter were issued during his residence at Mount Hamilton. His administrative duties did not leave much time for personal research.

The Lick Observatory had been planned and was essentially completed before astronomers realized that electricity and photography would become the chief servants in the great observatories. It was one of Director Holden's first duties to provide photographic equipment. The 33-inch correcting lens, to convert the 36-inch visual refractor into a 33-inch photographic instrument, was finished in 1888; the Willard-Crocker photographic telescope was completed in 1890; the D. O. Mills spectograph was provided in 1894; and the Crossley reflecting telescope was secured in 1895 and installed in 1896. An electric plant to supply current for purely scientific purposes was provided by gift of Thomas A. Edison in 1891. The instruments here noted were used by the members of the staff in developing several exceedingly fruitful fields of research.

Five expeditions were sent out by Director Holden to observe total solar eclipses: January, 1889, in northern California; December, 1889, in French Guiana; April, 1893, in Chile; June, 1896, in Japan; and January, 1898, in India.

The last years of Professor Holden's administration were marred by the existence of animosities in the observatory community and by much ill-advised criticism in the newspapers. The time has not come for any member of the staff under his administration to attempt a critical analysis of the situation, and I shall let a distinguished non-partisan speak. To quote again from Newcomb's Reminiscences, pages 192-193:

"The term of Holden's administration extended through some ten years. To me its most singular feature was the constantly growing unpopularity of the director. I call it singular because, if we confine ourselves to the record, it would be difficult to assign any obvious reason for it. One fact is indisputable, and that is the wonderful success of the director in selecting young men who were to make the institution famous by their abilities and industry. If the highest problem of administration is to select the right men, the new director certainly mastered it. So far as liberty of research and publication went, the administration had the appearance of being liberal in the extreme. Doubtless there was another side to the question."

Professor Holden's astronomical career practically terminated with his departure from Mount Hamilton in October, 1897. He resided in New York city until the latter part of 1901, where much of his time was devoted to the writing of

popular articles and books on astronomical subjects of every-day interest.

From November, 1901, until his death he was librarian of the United States Military Academy at West Point, New York. When his former associates heard of this appointment they said without hesitation: "He will be wonderfully successful," and so it seems he was. In 1907 the well-known journal, Army and Navy Life, inaugurated a series of biographies of "Distinguished Graduates of the United States Military Academy in Civil Life," by beginning "this series of articles with a brief survey of the distinguished career of the Academy's most learned living alumnus, Dr. Edward Singleton Holden," prepared by Capt. E. G. Davis, U. S. A. I shall let Professor Holden's biographer speak of his services to the library of the Military Academy:

"* * * He has labored unceasingly, within the means at his command, to make the library meet the legitimate needs of every instructor and every cadet.

"He saw from the first the magnitude of this last great task which he has undertaken. He found the library fairly well supplied with books on every subject, but their contents were not readily available. His first task was to complete the collection, so that every subject is now represented by the standard books that give its past history, as well as by the current periodicals which exhibit its present progress. Some 30,000 volumes have been added to the library since 1901. * * *

"All the new books of the library and all the military books, whether new or old, have been thoroughly catalogued and made available to instructors and others. A veritable mine of information has been opened for them in which they can find unlimited material for the extension of their professional studies or for original research in any field.

"Every nook and cranny of the library has been ransacked and Doctor Holden has personally examined every paper in the records of the bureaus of the War Department from the beginning of 1838 (the date of the fire which destroyed the records at West Point), making copies of all the important MSS. So that now for the first time since 1838 the historical records at West Point are substantially complete. Many orderly books, etc., have been acquired by gift or purchase.

"All of this material has been catalogued and much of it has been thoroughly gone over, either by Doctor Holden himself or under his direction by officers who have voluntarily assisted him in this work. * * *

"His report as librarian for the last year shows that about twenty-five per cent of the younger officers did volunteer work for the library and that more than one-third of the officers of the post were there engaged in serious work and many more at their own quarters. * * *

"Recently an officer, who was to deliver a lecture to the student officers at a near-by post, wrote to Doctor Holden asking for assistance in the collection of historical data concerning the development of a particular military subject.

"'Visit the library,' replied the Doctor, 'and all our books and manuscripts relating to this subject will be placed at your disposal.'

"The officer came. He found a table piled high with books and papers, containing, perhaps, every treatment of the subject from the time of the Greeks and Romans down to the present. He was inclined to despair when he saw the mass of material before him. To wade through such a pile of books seemed an endless task. But to his astonishment he found that the work had been more than half done for him; he was furnished with a manuscript bibliography of his subject, which gave him in a moment just what the various books contained and told him where to look for it. He went away delighted and enthusiastic. Doctor Holden has prepared similar complete bibliographies on every military subject. As soon as funds are available they are to be printed and distributed to the service. When this is done officers will know just what data are available for the study of any military subject in which they may be interested."

Professor Holden's interests took a wide range. He has written and published on the bastion system of fortifications; on the number of words used in speaking and writing; on the celebrated cipher dispatches of 1876 relating to the election of a President of the United States in that year; on the treatment of pamphlets in special libraries; on studies in Central American picture writing; on a system of local warnings against tornadoes; "The Mogul Emperors of Hindustan," a delightful volume published in 1895; a volume on "Mountain Observatories in America and Europe" (1896); a volume of "Memorials of W. C. and G. P. Bond" (1897); a "Catalogue of Earthquakes on the Pacific Coast, 1769 to 1897" (1898); a volume entitled "Earth and Sky" (1898); "Our Country's Flag" (1898); a "Primer of Heraldry" (1898); "Elementary Astronomy" (1899); a volume on the "Family of the Sun" (1899); "Essays in Astronomy" (1900), by various authors, including three by himself; "Stories of the Great Astronomers" (1903); "Real Things in Nature" (1903); "The Sciences" (1903); the "Centennial History of the United States Military Academy, 1802-1902," Vol. II, containing a full bibliography of West Point for 1524-1902, of the Military

Academy for 1776-1902, and of the writings of all graduates of the Military Academy during 1802-1902. There are many magazine articles on still other subjects.

Distinguished honors were bestowed upon Professor Holden. He was elected foreign associate of the Royal Astronomical Society in 1884; a member of the National Academy of Sciences in 1885; and later to membership in the Astronomical Society of France, in the Italian Spectroscopic Society, in the American Academy of Arts and Sciences, in the American Philosophical Society, etc. He received honorary degrees: M. A. from Washington University in 1879, LL. D. from the University of Wisconsin in 1886, LL. D. from Columbia University in 1887, Sc. D. from the University of the Pacific in 1896, and Litt. D. from Fordham College in 1910. He served as a member of the board of visitors to the United States Military Academy in 1885, and of the board of visitors to the United States Naval Academy in 1896. The reports of the boards of visitors for those years were live documents. He was made a knight commander of the Ernestine Order of Saxony in 1894, and a knight of the Royal Order of the Dannebrog in 1895, and the Order of Bolivar was conferred upon him in 1896.

Professor Holden possessed abilities wonderful in many ways. His knowledge of literature, both general and scientific, including, of course, the literature of astronomy, was very extensive, and this knowledge appeared always to be at his immediate command. He enjoyed writing; he wrote rapidly and with a fine literary style. It is a remarkable fact that the heavy correspondence of the Lick Observatory was conducted by Professor Holden's personal pen throughout his term of office. He did not utilize the services of a stenographer and only an occasional letter was copied with the typewriter. His social abilities were of very high order. His conversation was entertaining to the point of brilliancy. His hearers did not always agree with his point of view, which he defended with vigor and skill, but no one could be found to deny that Professor Holden had made the subject seem alive. His lamented death on March 16, 1914, marked the passing of an extremely interesting man.

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