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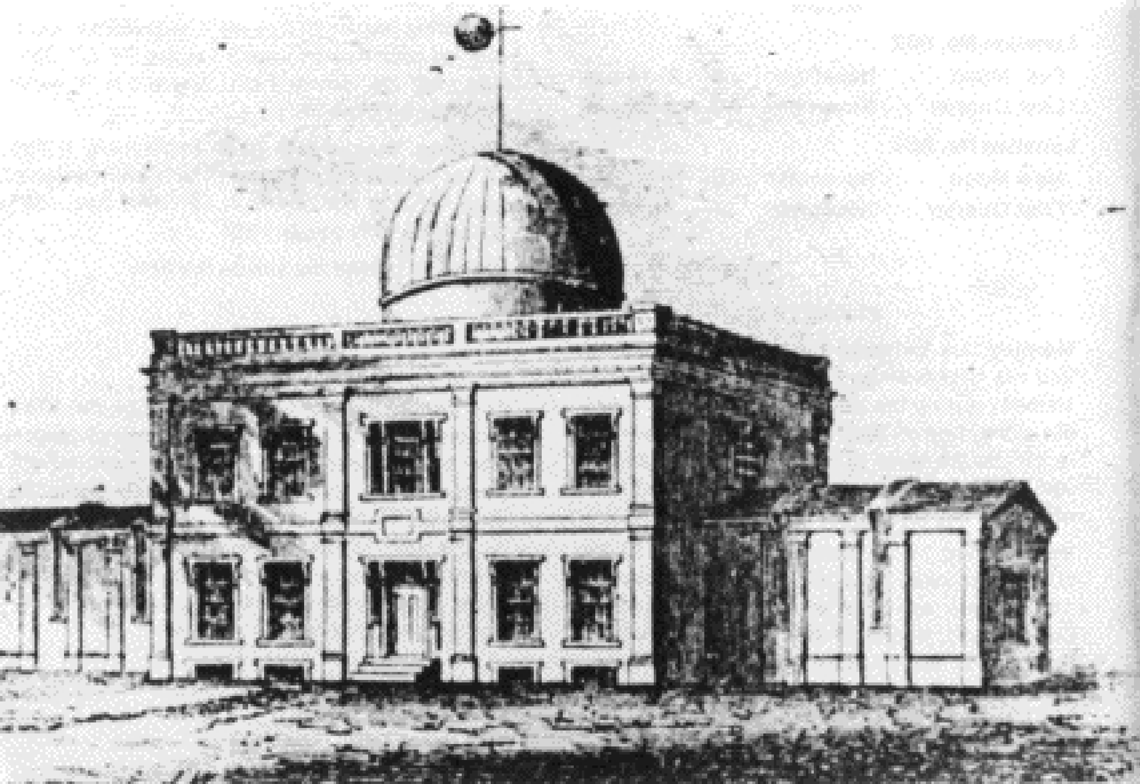
FRONT COVER

Seated in the observer's chair of the Great Equatorial telescope of the U.S. Naval Observatory, Simon Newcomb appears to be ready to put the instrument to use. This photograph was taken in 1873, shortly after the telescope's installation as the world's largest refractor. Joining him in this formal scientific portrait, the Observatory superintendent, Commander Benjamin F. Sands, sits nearby. (U.S. Naval Observatory courtesy Dr. LeRoy Doggett)



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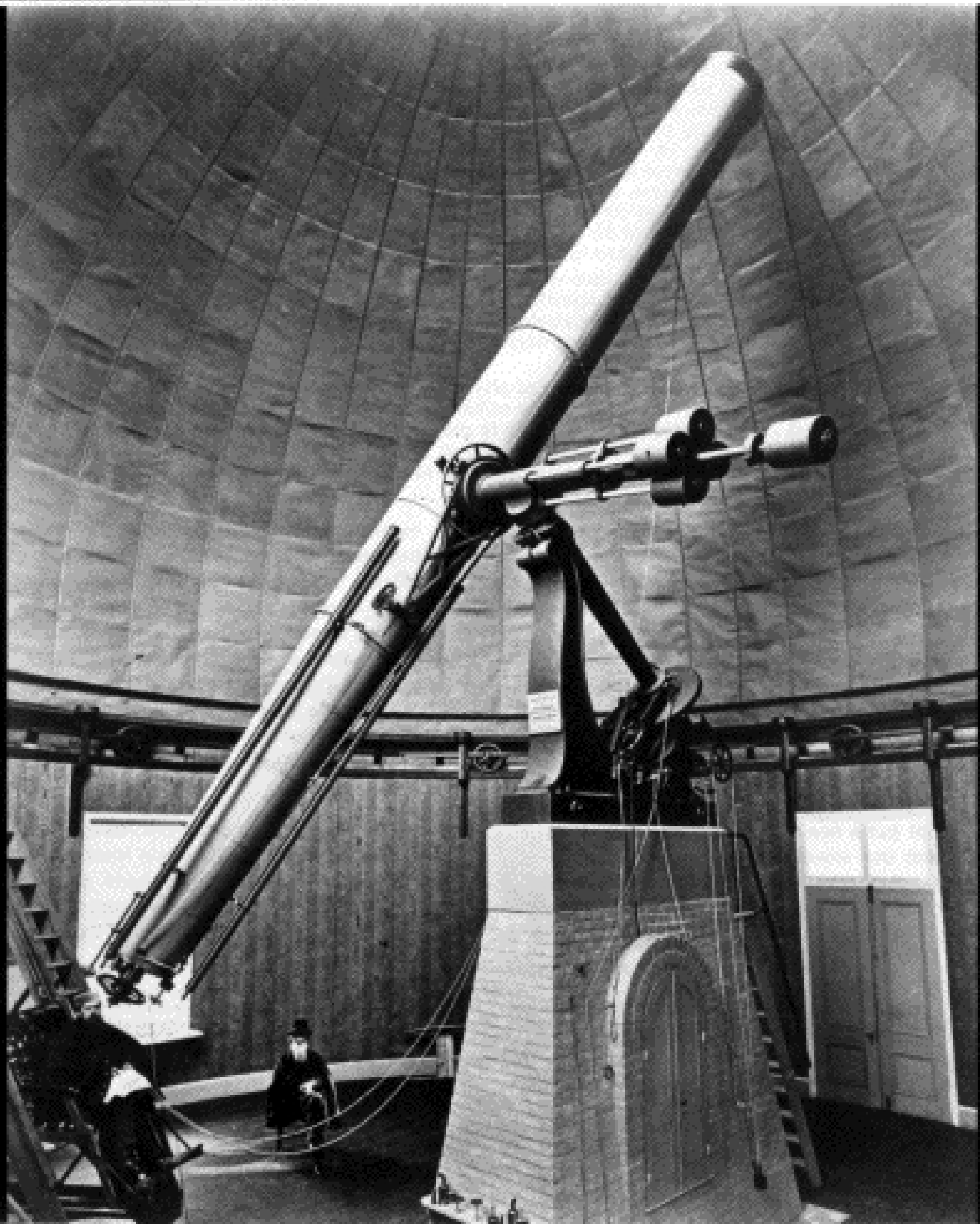

Simon Newcomb A Famous and Forgotten American Astronomer

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HONORABLE MENTION

HUGHES *GRIFFITH OBSERVER* CONTEST
1986

Simon Newcomb's brand of astronomy was not particularly colorful by today's standards, but it was fundamental. Most of what he contributed has little direct bearing on the concerns of modern astrophysics, but the system of standardized astronomical constants he helped develop in 1896 is still in use and is a basis of our astronomical knowledge. Although he was a leader of the astronomical and scientific community, he had a realistic sense of his limits. At the American Astronomical Society meeting in 1900 he remarked, "Some one has divided astronomers into two classes, those who talk about things to be done, and those who go to work and do them. In the present case [Favorable opposition of the minor planet Eros] I am afraid we shall have to enroll ourselves in the first class, because it is not easy to do anthing in this matter, the situation in this country not being favorable to the determination we have in view."

Dr. Joseph S. Tenn reacquaints us now with the man who was the first president of the American Astronomical Society. Dr. Tenn's last contribution to this contest and this magazine — "The Hugginses, the Drapers, and the Rise of Astrophysics" — was published in our October, 1986, issue, and the proper use of plurals in the proper names of the title demonstrates at a glance that he is a careful and thoughtful writer.

With an enviable profession as professor of physics and astronomy at Sonoma State University in the California wine country, Dr. Tenn and his colleagues have built an astronomy program that includes 11 undergraduate courses. Although he is pleased with his own awards in this contest, he reports that what really satisfies him is the fact that two of his students have also each won an Honorable Mention. A native of Los Angeles, Dr. Tenn is a graduate of Stanford and the University of Washington.

In 1898 the nine-year-old Astronomical Society of the Pacific made the first award of the Catherine Wolfe Bruce gold medal "for distinguished service to astronomy." In accordance with the wishes of the donor, the medal was to be "international in character, and (might) be awarded to citizens of any country and to persons of either sex." The A.S.P. president, San Francisco banker William Alvord, reported

> **. . . of all the names of living astronomers that have been so brilliantly connected with the wonderful advances in astronomical research during the past half century, with all the manifold branches of observational work, mathematical investigation, spectroscopic and photographic study in which to seek out a worthy exponent for this distinction, one name stood forward so prominently in the communications from heads of six leading observatories of the world, that the Directors of this Society could but set the seal of their approval upon the verdict of his peers, and award the first Bruce Medal to Professor SIMON NEWCOMB.**[1]

The choice surprised no one. Newcomb had already received similar medals from the Royal Astronomical Society, the Holland Society of Science, the Royal Society of London, and the Imperial Academy of Sciences in Russia. He

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had received or soon would receive other honors from learned societies in the United States, England, Germany, France Sweden, Russia, Holland, Scotland, Ireland, Canada, Belgium, Italy, Australia, Mexico, Austria, Switzerland, and Denmark, and he would collect a total of seventeen honorary doctorates from the leading universities of nine nations.

According to Brian Marsden, "Simon Newcomb was the most honored American scientist of his time."[2] In 1916 Raymond C. Archibald wrote in *Science*, "No other American scientist has ever achieved such general recognition of eminence."[3] President William Howard Taft attended his funeral in Arlington National Cemetery.

Newcomb was the only American among the first six Bruce medalists.

Who? You can search through many of today's astronomy texts without coming across a reference to Simon Newcomb. He made no important discoveries. Indeed, many astronomers of today fail to recognize the name of the man who, 75 years ago, was referred to in the leading British astronomy journal as "worthy to rank with the great astronomers of all time."[4]

Simon Newcomb was a "practical astronomer." Allow him to explain:

> **Should the reader ask what Practical Astronomy is, the best answer might be give him by a statement of one of its operations, showing how eminently practical our science is. "Place an astronomer on board a ship; blindfold him; carry him by any route to any ocean on the globe, whether under the tropics or in one of the frigid zones; land him on the wildest rock that can be found; remove his bandage, and give him a chronometer regulated to Greenwich or Washington time, a transit instrument with proper appliances, and the necessary books and tables, and in a single clear night he can tell his position within a hundred yards by observations of the stars.**[5]

In the last quarter of the nineteenth century Simon Newcomb directed the annual preparation and publication of *American Ephemeris and Nautical Almanac*. As he described it,

> **It is quite a large volume, from which the world draws all its knowledge of the times and seasons, the motions of the heavenly bodies, the past and future positions of the stars and planets, eclipses, and celestial phenomena generally which admit of prediction.**[6]

We have not yet explained all those awards. The noted astronomer Charles Greeley Abbott, writing in the *Dictionary of American Biography*, described Newcomb's greatest achievements:

> **Immediately after assuming his new responsibilities (as superintendent of the Nautical Almanac Office), Newcomb conceived the astonishing program of**

critically reforming the entire basis of fundamental data involved in the computation of the Ephemeris. The fundamental star places, the mass and distance of the sun, the motion of the moon, and the masses and orbits of the planets and their satellites, all were to be redetermined and new tables computed to suit the revised theory. Surprising to relate, he was able to accomplish all of this during his own lifetime excepting new tables of the moon's motion, which have since his death been computed by Prof. Ernest W. Brown of Yale University. Newcomb's program involved the discussion of all the worthwhile observations of the positions of sun, moon, and planets, as well as those of many of the fixed stars, which had been made at the principal observatories of the world since 1750.[7]

It was an unprecedented program. Newcomb achieved such precision that some of his tables were used to prepare the annual ephemeris until 1984! Yes, decades after the development of high-speed electronic computers, astronomers were still predicting risings and settings of the sun and planets with tables produced by this nineteenth century astronomer to whom a "computer" was a low-paid drudge with a book of logarithms.

Before going into more detail about Newcomb's achievement, let us look at another aspect of his career, one which may possibly help explain why he became such a hero.

Horatio Alger, Jr. was one of the most popular American writers of his time. His children's books influenced a great many Americans during the age of expansion and industrialization. His stories featured poor boys who made their way to the top through courage, pluck, and hard work.

No character in Horatio Alger's fiction more typified this scenario than Simon Newcomb. Coincidentally, Alger and Newcomb were only a year apart in age, and they were at Harvard at the same time. Perhaps the "Horatio Alger" story partially accounts for Newcomb's fame, but it is difficult to see how it would impress the Europeans.

Newcomb began his 1903 autobiography, *The Reminiscences of an Astronomer,*

I date my birth into the world of sweetness and light on one frosty morning in January, 1857, when I took my seat between two well-known mathematicians, before a blazing fire in the office of the "Nautical Almanac" at Cambridge, Mass.

The 21 year-old-Newcomb had never before met anyone with whom he could discuss the subject which excited him — celestial mechanics. Born 12 March 1835 in rural Nova Scotia, of "almost pure New England descent," he had been raised in an area where

The work of the men and boys was "from sun to sun," — I might almost say from daylight to darkness, — as they tilled the ground, mended the fences, or cut lumber, wood, and stone for export to more favored climes The women and girls sheared the sheep, carded the wool, spun the yarn, wove the homespun cloth, and made the clothes.

The son of a country school teacher, Newcomb showed a proclivity for learning at an early age. He quickly mastered arithmetic and was reading philosophy at the age of ten. His neighbors considered the boy somewhat strange, poring over Euclid when others were doing more useful things.

The skill required on a farm was above my reach, where efficiency in driving oxen was one of the most valued of accomplishments. I keenly felt my inability to acquire even respectable mediocrity in this branch of the agricultural profession. . . . I had indeed gradually formed, from reading, a vague conception of a different kind of world, — a world of light, — where dwelt men who wrote books and people who knew the men who wrote books, — where lived boys who went to college and devoted themselves to learning, instead of driving oxen. I longed much to get into this world, but no possibility of doing so presented itself.

At 16 Simon was apprenticed to a local doctor, a practitioner of herbal medicine who turned out to be a fraud. The boy stuck it out for two years of drudgery, learning nothing, then ran away. He walked a hundred miles to the coast, then worked for his passage to Massachusetts. There he met his recently widowed father, and the two made their way to Maryland, where Simon became a country school teacher, too.

In 1854 I availed myself of my summer vacation to pay my first visit to the national capital, little dreaming that it would ever be my home. I went as far as the gate of the observatory, and looked wistfully in, but feared to enter, as I did not know what the rules might be regarding visitors.

The eager youth read everything he could find. He soon decided that "mathematics was the study I was best fitted to follow," although his choice of texts was hardly what a teacher would recommend. He tried to read Newton's *Principia* and claimed to have obtained "the spirit here and there." In early 1856 he found a job tutoring a family within a short horseback ride of the capital. Soon he was borrowing books at the Smithsonian library. After some trepidation, he managed to meet the institution's celebrated head, physicist Joseph Henry.

Through Henry the young man met the director of the Coast Survey and borrowed and studied a number of mathematical and scientific books. At last he entered "the world of sweetness and light" when he obtained a position as a computer at the Nautical Almanac office.

The job required a move — at that time the office was in Cambridge Massachusetts, where its employees could avail themselves of the advice of the nation's leading mathematical astronomer, Professor Benjamin Peirce of Harvard. Newcomb was now surrounded by "men who read books," and his job required only that he put in five hours a day at his convenience. In fact he could work as few hours and whenever and wherever he chose, so long as he completed his work on time.

He immediately enrolled in the Lawrence Scientific School of Harvard and, after eighteen months of study, received his B. S. in 1858.

It was while at Cambridge that Newcomb published his first significant research. The German astronomer Heinrich Olbers had suggested that all of the minor planets originated in the breakup of a single large planet that once orbited the sun between Mars and Jupiter. The 25 year-old Newcomb computed the orbits of a number of the larger asteroids back several hundred thousand years and showed that they never intercepted; they could not have come from a single parent body.

In 1861 Abraham Lincoln took office as President, and the southern states seceded from the Union. One consequence was that many southern-born goverment officials resigned their positions and left to serve the Confederacy. This left a number of vacancies, one of which, at the United States Naval Observatory, was filled by Simon Newcomb.

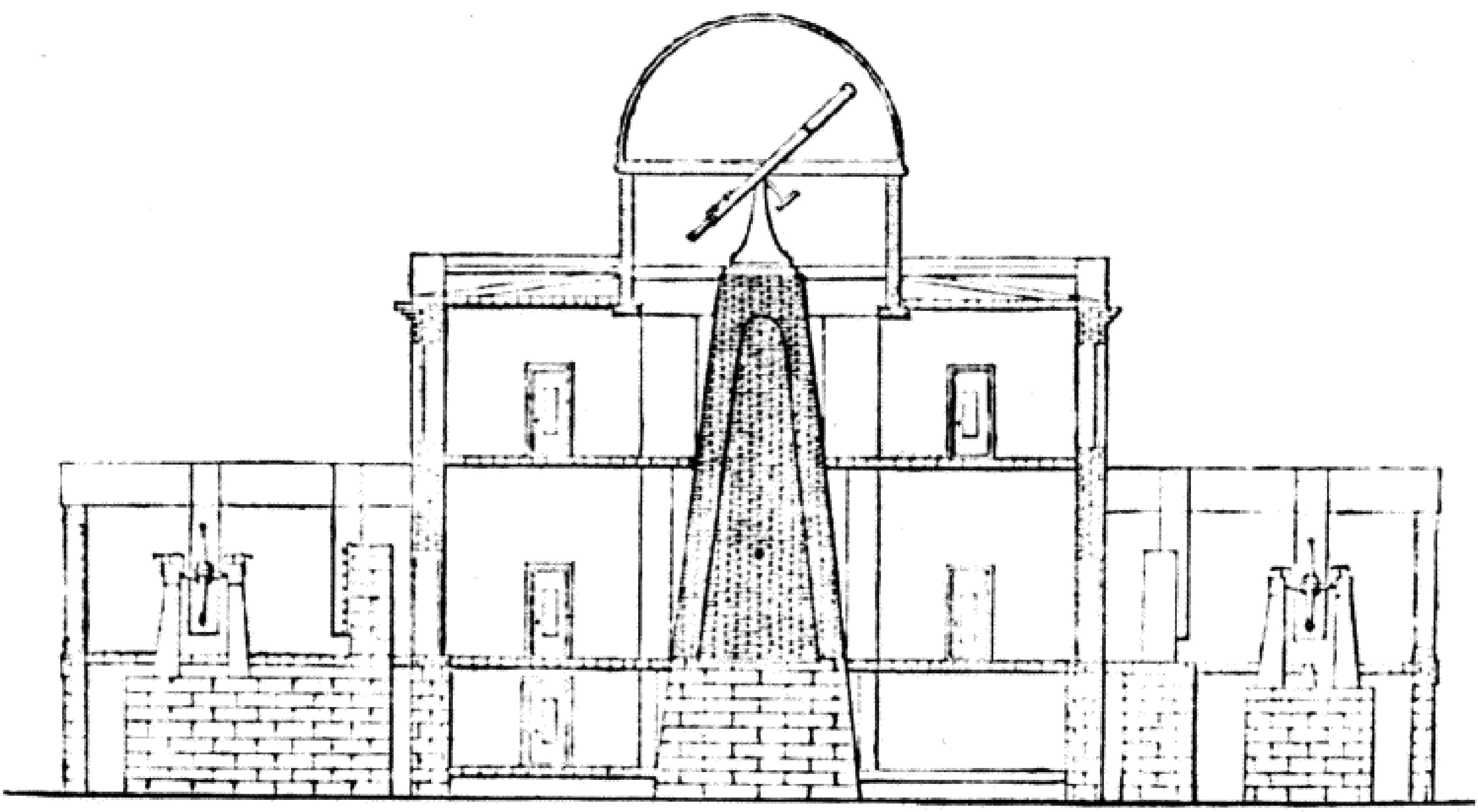
Founded in 1830 as a "Depot for Charts and Instruments" and officially denoted an observatory in 1844, the U.S.N.O. was staffed by regular naval officers and by astronomers who were titled professors of mathematics and commissioned as naval officers. The first director, Lt. (later Commodore) Matthew Maury, devoted most of his considerable energy and talent to founding the science of oceanography and left the astronomers alone to do as they wished. He was one of the southerners who left.

The astronomical purpose of the observatory was the same as that of its older counterparts in Greenwich and Paris: To provide the necessary data for the preparation of the nautical almanac and to establish time and longitude. Longitude measurements were particularly important in the United States where only astronomical measurements could determine the boundaries of the western states and territories. A necessary consequence was the need to determine the positions of the stars with the greatest precision obtainable.

Newcomb had hesitated to apply for the observatory position because of his "aversion to late night work." He soon found that there was no problem: The astronomers seldom observed more than a few hours. He was assigned to assist Professor Mordecai Yarnall on the mural circle.

The young man found the work poorly organized. Joseph Hubbard would use a transit instrument to determine the right ascension of a star; Yarnall or Newcomb, across the room, would measure declination with the mural circle. There was no coordination; each astronomer would determine a coordinate of whichever stars took his fancy, and few stars had both coordinates measured.

No one worked very hard. "When either Hub-



The original building for the U.S. Naval Observatory was equipped with a 9½-inch refractor on a high central pier that extended through three floors of the building to the main dome. Auxiliary instruments — meridian transits and others — occupied the neighboring wings. When Newcomb first came to the U.S. Naval Observatory, he was assigned to work with the mural circle in one of these subsidiary rooms. (Harper's New Monthly Magazine, 1856).

bard or myself got tired, we could 'vote it cloudy' and go out for a plate of oysters at a neighboring restaurant."

The Civil War brought a reduced staff and increased responsibilities at the observatory. It also brought Lt. James Gilliss as Superintendent. A devoted and professional astronomer, Gilliss had actually designed and built the Observatory 17 years before, but had been passed over for the Superintendent's position. He quickly recognized the ability and drive of his new "Professors," two of whom — Newcomb and Asaph Hall — were to make names for themselves as astronomers. Despite numerous inconveniences, even having to take up arms in defense of the Capital at one point, the astronomers were able to improve greatly the productivity of the Observatory.

Newcomb was placed in charge of the mural circle and was able to systematize the observations of stars, in accordance with the practices of Greenwich. During the war he married — his wife was the granddaughter of the founder of the U.S. Coast Survey — and began taking part in Washington society. The year 1865 brought Lincoln's assassination and the end of the war, and then what Newcomb called "the greatest event in the history of the observatory": The mounting of a new, state-of-the-art, transit circle, imported from Germany. With this instrument he saw the United States as independent of Europe at last, for now Americans could determine longitudes and times without recourse to others' observations.

Put in charge of the new instrument, he mapped out a four-year plan of "fundamental work," the redetermination of the positions of the stars without reference to prior observations.

He was not to be an observer for long. In Marsden's words, "Newcomb had great respect, but no particular love, for observational work." Newcomb himself wrote that

> **I had found that very difficult mathematical investigations were urgently needed to unravel one of the greatest mysteries of astronomy, that of the moon's motion. This was a much more important work than making observations, and I wished to try my hand at it.**

He gave a fuller description of what was to be his main work years later:

> **When the theory of universal gravitation was propounded by Newton he showed**

> **that a planet subjected only to the gravitation of a central body, like the sun, would move in exact accordance with Kepler's laws. But by his theory the planets must attract one another and these attractions must cause the motions of each to deviate slightly from the laws in question. Since such deviations were actually observed it was very natural to conclude that they were due to this cause, but how shall we prove it? To do this with all the rigor required in a mathematical investigation it is necessary to calculate the effect of the mutual action of the planets in changing their orbits. This calculation must be made with such precision that there shall be no doubt respecting the result of the theory. Then its results must be compared with the best observations. If the slightest outstanding difference is established there is something wrong and the requirements of astronomical science are not satisfied.**[8]

After unsuccessful attempts to become head of the Nautical Almanac Office and of the Naval Observatory, he asked to transfer to the Nautical Almanac office (it had moved to Washington in 1866) to devote full time to theoretical work. He was told he could stay and work on such calculations at the Naval Observatory. He was freed of tedious observing tasks at last.

Newcomb found this desicion fortunate, since "As things go in Washington, the man who does his work in a fine public building can gain consideration for it much more readily than if he does it in a hired office like that which the 'Nautical Almanac' then occupied."[9]

In 1866 Newcomb published his first investigations of the orbit of Neptune. It was just two decades since that planet's discovery as the result of Urbain J. J. Leverrier's calculations of the perturbations of the orbit of Uranus. Newcomb's work on Neptune, and later on Uranus, would result in the first of those gold medals.

The work on the moon's motion brought further acclaim. Newcomb decided that the best current theory, due to the German astronomer Peter Hansen, needed further testing. Hansen had constructed the model so as to agree with observations of the moon dating back to 1750. Newcomb thought he could extend the period by making use of old observations of occultations in the Paris observatory. After observing the 1870 solar eclipse at Gibraltar, and then waiting out the end of the Franco-Prussian War visiting astronomers in Italy, Russia, and Germany, he entered Paris in March, 1871. The war had just ended, and the Paris Commune had taken over much of the city; he pored over the ancient records to the sound of cannon fire. Success was achieved: Newcomb was able to determine the motion of the moon back to 1675 from the old records and thus to show Hansen's theory required modification. Regarding Hansen, whom he visited shortly after the latter attacked him for some earlier criticisms, he wrote,

> **To be revised, pulled to pieces, or superseded, as science advances, is the common fate of most astronomical work, even the best. It does not follow that it has been done in vain; if good, it forms a foundation on which others will build. But not every great investigator can look on with philosophic calm when he sees his work thus treated, and Hansen was among the last who could.**[10]

The continued connection with the Naval Observatory also permitted Newcomb to take part in other important projects: Observations of the transits of Venus (unsuccessful; his advice not to bother with the second transit proved correct)[11] and the development of the world's largest refracting telescopes.

Three times he worked with Alvan Clark and Sons of Cambridgeport, Massachusetts, to contract for, help design, and/or supervise the inauguration of the world's largest refractor. Starting in 1868 Newcomb pointed out the embarrasing fact that nation's leading observatory, the U.S.N.O., lacked a large telescope and thus suffered by comparison to its European counterparts. When Congress at last provided the funds, he helped convince his superiors of the capabilities of the Clarks and helped design the 26-inch Great Equatorial of the Naval Observatory. Upon its completion in 1873 he took charge of the instrument and observed — mostly satellites in order to get better values for planetary masses — for two years before turning it over to Hall. The latter promptly began his successful search for Martian satellites.

The following year Newcomb received a letter from Otto Wilhelm von Struve. The director of the Pulkovo Observatory in Russia

Simon Newcomb was a family man, and here he is with his family, in 1874, outside the U.S. Naval Observatory. His oldest daughter (on the right) later became a surgeon and head of the Army Nurse Corps (Dr. Anita Newcomb McGee). (photograph Mrs. Simon Newcomb Whitney)

wanted advice on building a great telescope. Newcomb highly recommended the Clarks, and, when Struve came to the U.S. in 1879, acted as advisor and broker, suggesting the conditions of the contract as an impartial third party trusted by both sides. The 30-inch telescope was a success, and Newcomb became the only American to have his portrait in the gallery of great astronomers at the Pulkovo Observatory.

More extensive was Newcomb's involvement in the building of the 36-inch telescope of the Lick Observatory. He was consulted as early as 1874 by the first of James Lick's three boards of trustees. He helped with a great many questions of location and design; he even nominated his assistant, Edward S. Holden, to be its first director.[12] It was at Newcomb's and Holden's suggestion that an astronomer, S. W. Burnham of Chicago, was sent with a telescope to test the seeing conditions before taking the radical new step of placing an observatory on a mountaintop.[13]

After the failure of the transit of Venus measurements to give better value for the distance to the sun, Newcomb became convinced that the best method involved measurement of the speed of light. The aberration of starlight, an effect similar to running into the rain, gives the ratio of the orbital speed of the earth to the speed of light. Hence a precise determination of the speed of light would yield the scale of the earth's orbit. He got a special appropriation from Congress and promptly set out to measure this important constant to new precision. The British historian of astronomy, Agnes Clerke, admiringly wrote:

> **All earlier efforts of the kind were thrown into the shade by Professor Newcomb's arduous operations at Washington in 1880-82. The scale upon which they were conducted was in itself impressive. Foucault's entire apparatus in 1862 had been enclosed in a single room; Newcomb's revolving and fixed mirrors, between which the rays of light were to run their timed course, were set up on opposite shores of the Potomac, at a distance of nearly four kilometres. This advantage was turned to the utmost account by ingenuity and skill in contrivance and execution, and the deduced velocity of 299,860 kilometres = 186,328 miles a second had an estimated error (30 kilometres) only one-tenth that ascribed by Cornu to his own result in 1874.**[14]

Don't think that these activities were sufficient to drain all of the energies of this amazing man. In 1873 he began lecturing at what is now George Washington University. He wrote extensively on economics, beginning with a little book denouncing the issuance of paper money during the Civil War. He quoted Copernicus, no less, in calling the debasement of currency one of the four greatest evils of all time, right behind war, death, and famine.

He wrote mathematical papers and, disgusted by the mathematics text one of his daughters was using, wrote an entire series of text: Algebra, geometry, trigonometry, analytical geometry, and calculus.

In 1875, already a recipient of the gold medal of the Royal Astronomical Society and of several honorary degrees, the forty-year-old Newcomb declined an invitation to become director of the Harvard College Observatory. He hesitated on this decision, even consulting the Secretary of the Navy — who urged him to go — but decided that

> **one ought to choose that line of activity for which Nature had best fitted him, trusting that the operation of moral causes would, in the end, right every wrong, rather than look out for place and preferment. I felt that the conduct of goverment astronomy was that line of activity for which I was best fitted, and that, in the absence of strong reason to the contrary, it had better not be changed. In addition to these general considerations was the special point that, in the course of a couple of years, the directorship of the Nautical Almanac would become vacant, and here would be an unequaled opportunity for carrying on the work in mathematical astronomy I had most at heart.**[15]

There was also the fact that Harvard's observatory was a much smaller and poorer institution than the Naval Observatory. "It was poor in means, meagre in instrumental outfit, and wanting in working assistants; I think the latter did not number more than three or four, with perhaps a few temporary employees, There seemed little prospect of doing much."[16] Newcomb acknowledged, years later, that the man who accepted the job, Edward C. Pickering, did accomplish a great deal and that Harvard had no reason to regret not getting Newcomb.

In 1876 Newcomb was elected president of the American Association for the Advancement of Science, and the following year he left the U.S.N.O. to achieve his long-sought goal — the directorship of the Nautical Almanac office. (In 1893 the office was put under the Naval Observatory when both moved into their present home. Newcomb would end his career back in the Observatory.)

Now he could put his program into action. It included "a discussion of all the observations of value on the positions of the sun, moon, and planets, and incidentally, on the bright fixed stars, made at the leading observatories of the world since 1750. One might almost say it involved repeating, in a space of ten or fifteen years, an important part of the world's work in astronomy for more than a century past. The number of meridian observations on the sun, Mercury, Venus, and Mars alone numbered 62,030."[17]

Of course he did not do all this work himself. "When the work was at its height, the office was, in the number of its scientific employees, nearly on an equality with the three or four greatest observatories of the world."[18] In the 1890s the Naval Observatory had by far the largest budget of the world's observatories.

Among Newcomb's assistants were some gifted mathematicians, including George W. Hill, a man of considerably greater mathematical ability than his boss. It was to Hill that Newcomb assigned the difficult problem of determining the motions of Jupiter and Saturn. Motions of the sun, moon, and remaining planets he reserved for himself.

In the 1880s and 90s Newcomb was atop the American scientific world. He was elected president of half a dozen societies, including the Political Economy Club of America, the Philosophical Society of Washington, and the American Mathematical Society. He served as Editor of the *American Journal of Mathematics*. He was one of the original faculty of Johns Hopkins University, where he lectured on astronomy and mathematics and also supervised doctoral dissertations in economics. He declined an offer to be president of the University of California.

He made several more trips to Europe, mostly to receive awards. A special act of Congress allowed him to accept the position of officer of the Legion of Honor from the French goverment.

Meanwhile his astronomy texts were going through numerous editions and translations, his collected magazine articles on economics and on astronomy were being published as books, and he was writing scores of articles for magazines and encyclopedias.

His economics texts read like his astronomy books. As the editors wrote in the preface when they reprinted one of his books in 1969,

> **As an economist he could not shake his endowments as an astronomer. Contemplating the heavens — the motions of the moon, the position of the stars, the velocity of light, the force of gravity — he could explain the phenomena before him in only one language — mathematics. Turning to men in motion, Newcomb insisted that they too could be understood best if their motives and motions were stated in mathematical**

terms. Making no allowances for the irrationality of human conduct, Newcomb held that in economic matters, as in heavenly matters, interference disrupted basic harmony. God had set the heavens in motion and, without interference, endless harmony and balance would prevail. In economic matters, strikes were an interference. So were trade unions and laziness and intemperance.[19]

He wrote on life insurance, on political questions, on religion, and on education. He won a prize for an anonymous essay on good citizenship. He wrote a utopian novel. He wrote anonymous editorials for newpapers in New York and Washington.

In some cases there was reason for anonymity. He was heavily involved behind the scenes in the long effort to put a civilian astronomer at the head of the U.S.N.O. There is little doubt whom he had in mind for the position. The effort was unsuccessful; to this day the superintendent of the U.S. Naval Observatory is a career naval officer, not an astronomer.

Newcomb played a major role in the founding of what is now called the American Astronomical Society. He suggested that an organization of professional astronomers be formed at the astronomers' conference held in conjunction with the dedication of the Yerkes Observatory in 1897, where he was (with James Keeler) one of the principal speakers. George Hale, who had founded Yerkes (and the *Astrophysical Journal)* wanted an organization that would unite physicists and astronomers. Other astronomers greatly feared that the society would be based in Washington and dominated by Newcomb. It took two years before the society was constituted at the third annual astronomers' conference in 1899. There was a major dispute over the name. Hale wanted to call it the American Astronomical and Physical Society. Newcomb amended this to American Astronomical and Astrophysical Society. but then the others rejected this because the initials A.A.A.S. were already in use by the American Association for the Advancement of Science. It became the somewhat cumbersome Astronomical and Astrophysical Society of America. It was not until five years after Newcomb's death — and the demise of an organization of Brooklyn amateurs called the American Astronomical Society — that the Society took the name which Newcomb has proposed in the first place. Newcomb was, of course, elected the first president. As Joel Stebbins said fifty years later, "He gave the Society the prestige of the foremost man of science of his time, in America." He served six years before relinquishing the post to Pickering.[20]

Newcomb's views on scientific topics would seldom be out of place today. He thought extraterrestrial life probable but saw no hope of making contact. He was unprejudiced enough to serve as the first president of the American Society for Psychical Research and to do considerable reading in the field, and scientist enough to come to the conclusion that "the phenomena brought out lacked that coherence and definiteness which is characteristic of scientific truths."[21] Watching demonstrations of levitation and psychokinesis, he easily detected frauds, and he concluded that "I am now likely to remain a skeptic as to every branch of 'occult science' until I find some manifestation of its reality more conclusive than any I have yet been able to find."

He made one serious error. He criticized Samuel Langley's efforts to build a flying machine, claiming that success was unlikely until a new principle of physics was discovered. Unfortunately for Newcomb, by this time a Grand Old Man of science, he published this in 1903, the very year of the Wright brothers' success.

His discussion of the precession of the orbit of the planet Mercury requires no apology. Writing on "Unsolved Problems in Astronomy" in *McClure's Magazine* in 1899, he concluded "So thoroughly has every possible explanation been sifted out and found wanting, that some astronomers are now inquiring whether the law of gravitation itself may not be a little different from what has always been supposed. A very slight deviation, indeed, would account for the facts, but cautious astronomers want other proofs before regarding the deviation of gravitation as an established fact."

It is noteworthy that he did not ridicule the idea of modifying Newton's law of gravity. After a lifetime of investigations, he had calmly come to the conclusion that this was the only way out. Unfortunately, he did not live to see Einstein propose the modification, or Arthur Eddington and Frank Dyson provide the "other proofs" at the 1919 solar eclipse.[22]

In 1897 Newcomb reached the age of 62. His work was not yet finished, he was still in his prime, but Navy regulations were rigid: He was forced to retire as superintendent of the Nautical Almanac Office. In an unusual gesture Congress provided funds for him to retain a small corps of assistants and to continue some of his work. Fortunately, the Carnegie Institution was established five years later, and its generous grants allowed him to complete the theory of the moon's motion just a month before his death on 11 July 1909.

It is hard to know what to think of Simon Newcomb. The man had incredibly broad interests and was one of the great organizers and scientist-politicians of all time. Yet his scientific achievements were not as great as those of some of his less-honored contemporaries. George Comstock accurately prophesied, "In the field of his first choice, theoretical astronomy, while his attainments were large and his powers great, it may be doubted whether posterity will rank his work as of the first order."[23] When Ernest W. Brown published the definitive *Tables of the Motion of the Moon* in 1919, he prefaced them, "With one or two corrections supplied by Newcomb, Hansen's Tables have fulfilled the needs of navigation and astronomy for over half a century."[24]

In 1976 the historian of science Stephen Brush made a study of the astronomers of the late 19th and early 20th centuries. In his listing of the ten most important astronomers of the period 1851-1900 Newcomb ranked ninth. (Sir William Huggins, the dedicated English amateur who made many of the first spectroscopic observations, was first. The other Americans on the list were Edward C. Pickering, fifth, and Edward E. Barnard, tenth.)[25]

Newcomb's writings show that he had a high opinion of himself, yet they are no more immodest than those of Edwin Hubble or Harlow Shapley. He was circumspect in his treatment of his contemporaries, often praising them highly. Most interesting in this regard is the case of his brilliant underling, G. W. Hill, who chose to do most of his work at his home in West Nyack, New York. Did the two really get along? In his eulogy in *Science,* Hill wrote the obligatory praise: "With almost universal consent, it is admitted that, for the last forty years of his life, Professor Newcomb stood at the head of the cultivators of the astronomy of position," but there seems to be some restraint.

There is no question but that Simon Newcomb was an intimidating person. Abbott described him:

> **As a presiding officer, he was a most extraordinary and impressive figure. Not unconscious of the high worth implied by the numerous honors, doctorates, and decorations heaped upon him from all parts of the world, he conducted himself with great dignity, heightened by the massive leonine head with its crown of iron-gray hair and the strong mouth framed by beard and mustache. To see him presiding at a meeting of astronomers was indeed a serious sight, well calculated to inspire awe of the profession in a youthful mind.**[26]

Another contemporary who knew him well, the astronomer George C. Comstock, expressed himself in similar terms:

> **Newcomb's leonine appearance and conscious dignity of bearing were not infrequently a source of awe to younger men who found it difficult to cross the supposed barrier between them. To the dullard or impostor the barrier was sometimes made real by a word of cutting sarcasm...**[27]

Yet his accomplishments were real, and he was one of the prime movers (along with Pickering and Hale) in taking American astronomy from next to nothing to a position of world leadership.

Perhaps this was as significant as the discoveries being made by others who were not so politically active. Science needs all kinds: Discoverers, leaders, and popularizers. Certainly Simon Newcomb was one of the greatest in the latter two categories. And today, as in his time, all of our great models of the universe rest on the precise measurements of position and motion which he made his life's work.

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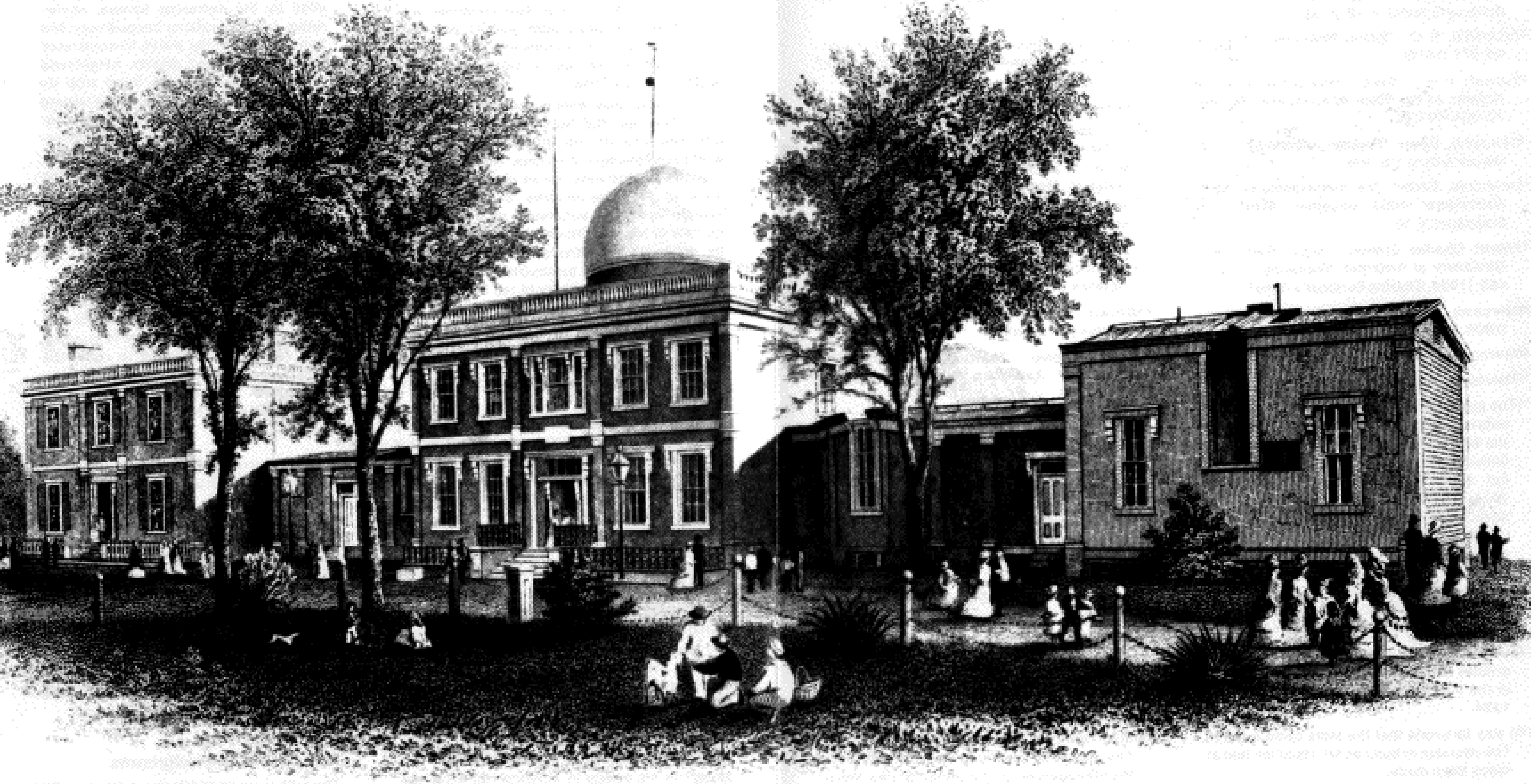

In 1876, the parklike setting of the U.S. Naval Observatory in Washington, D.C.'s Foggy Bottom inspired locals to picnic by the dome of the 26-inch Great Equatorial and by the Washington Time Ball, on the pole above the upper dome, which housed the observatory's 9½-inch refractor. (U.S. Naval Observatory, courtesy Jan K. Herman)

NOTES

[1]Alvord, William: *Pubs. Astron. Soc. Pacific 10,* 49-50 (1898).

[2]Marsden, Brian G.: "Simon Newcomb," *Dictionary of Scientific Biography* (1974, Charles Scribner's Sons), v. 10, p. 33.

[3]Archibald, R C.: "Simon Newcomb, "*Science* 46, 871 (1916).

[4]Turner, H.H.: "Simon Newcomb," *Monthly Notices of the Royal Astronomical Society,* 70, 304 (1910).

[5]Newcomb, Simon: *Popular Astronomy* (1877, Harper & Bros.), p. 103.

[6]Newcomb, Simon: *The Reminiscences of an Astronomer* (1903, Houghton, Mifflin and Company), p. 63.

[7]Abbott, Charles Greeley: "Simon Newcomb," *Dictionary of American Biography,* v. 13, p. 452. (1934, Charles Scribner's Sons).

[8]Newcomb, Simon: *Side-lights on Astronomy* (1906, Harper & Bros.), p. 207.

[9]Newcomb, *Reminiscences,* p. 115-116.

[10]Newcomb, *Reminiscences,* p. 318.

[11]The purpose of the transit expeditions was to obtain a better value for the distance from the earth to the sun. This quantity, the astronomical unit, is the basis for all astronomical distance measurements. When the 1874 expeditions failed to obtain good results (most teams were clouded out), Newcomb and Pickering advised against making another expensive attempt in 1882. Outvoted, Newcomb led a team to the Cape of Good Hope. After years of attempts at reduction (not by Newcomb), the observations were abandoned, unpublished.

[12]For the outcome, see the fascinating pair of articles on Holden by Donald E. Osterbrock in the *Journal for the History of Astronomy,* 1984.

[13]It was fortunate that the tests came out well. The decision to build on Mt. Hamilton had already been made.

[14]Clerke, Agnes: *Astronomy in the 19th Century* 3rd ed. (1893, Adam and Charles Black), p. 297. The modern value for the speed of light is 299,792.456 km/sec.

[15]Newcomb: *Reminiscences,* p. 213.

[16]Newcomb: *Reminiscences,* p. 212.

[17]Newcomb: *Reminiscences,* p. 217.

[18]Newcomb: *Reminiscences,* p. 217.

[19]Stein, Leon and Phillip Taft: preface to Newcomb, Simon: *A Plain Man's Talk on the Labor Question* (1969, Arno & and the *New York Times*).

[20]Berendzen, Richard: "Origins of the American Astronomical Society," *Physics Today 27,* 12, 32 (1974).

[21]Newcomb: *Reminiscences,* p. 411.

[22]For a discussion of the first experimental test of General Relativity see J. S. Tenn's article on A. S. Eddington in the Nov./Dec. 1982 issue of *Mercury.* For Einstein's appreciation of Newcomb see his letter to Newcomb's daughter in *Science* 69, 248 (March 1, 1929).

[23]Comstock, George C.: "Simon Newcomb," *Science 30,* 357 (1909).

[24]Brown, Ernest W.: *Table of the Moon's Motion* (1919, Yale).

[25]Brush, Stephen: "The Rise of Astronomy in America," *American Studies 20,* 2, 41 (1979).

[26]Abbott, p 454.

[27]Comstock, p. 358.

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