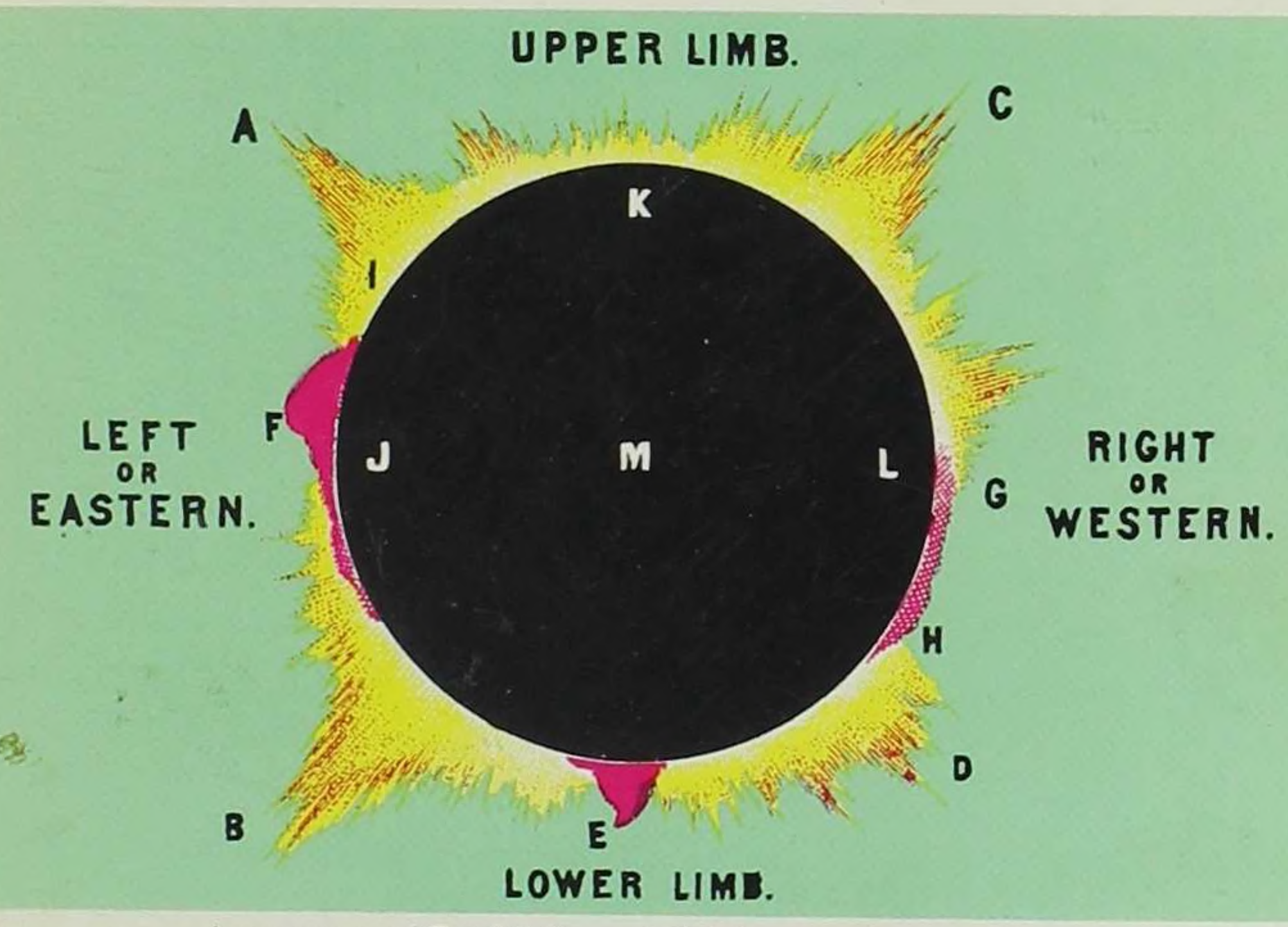
The PALIMPSEST



Appearance of Total Eclipse at Oskaloosa — August 7, 1869

The Total Eclipse of 1869

Published Monthly by
The State Historical Society of Iowa
Iowa City, Iowa
FEBRUARY 1970
SPECIAL ECLIPSE ISSUE — FIFTY CENTS

The Meaning of Palimpsest

In early times a palimpsest was a parchment or other material from which one or more writings had been erased to give room for later records. But the erasures were not always complete; and so it became the fascinating task of scholars not only to translate the later records but also to reconstruct the original writings by deciphering the dim fragments of letters partly erased and partly covered by subsequent texts.

The history of Iowa may be likened to a palimpsest which holds the record of successive generations. To decipher these records of the past, reconstruct them, and tell the stories which they contain is the task of those who write history.

Contents

THE TOTAL ECLIPSE OF 1869

Illustrations

Illustrations, as noted, are from three early textbooks on astronomy. The Burlington photos are from the State Historical Society of Iowa collection and the Des Moines photos are used by the courtesy of the State Department of History and Archives.

Authors

Ben Hur Wilson was a frequent contributor to *The Palimpsest*. He served for many years as Editor-in-Chief of *Earth Science*. William J. Petersen is superintendent of the State Historical Society of Iowa. M. S. deVere was a professor of astronomy at the University of Virginia.

THE PALIMPSEST is published monthly by the State Historical Society of Iowa in Iowa City, William J. Petersen, Editor. It is printed in Iowa City and distributed free to Society members, depositories, and exchanges. This is the February, 1970, issue and is Number 2 of Volume 51. Second class postage paid at Iowa City, Iowa.

PRICE—Included in Membership. Regular issues, 25¢; Special—50¢

MEMBERSHIP — By application. Annual Dues $5.00

ADDRESS—The State Historical Society, 402 Iowa Avenue
Iowa City, Iowa 52240

THE PALIMPSEST

EDITED BY WILLIAM J. PETERSEN

VOL. LI ISSUED IN FEBRUARY 1970 NO. 2

The Eclipse of 1869

The Man in the Moon wears a long black dunce cap of enormous dimensions, which he always keeps pointing away from the sun. Frequently, on his journeys round the world, as if in a mood for flirtation, he draws the apex of his cap across the face of Old Lady Earth in a great sweeping curve. With marvelous rapidity the great moon shadow travels thousands of miles and then passes off into space and invisibility.

Such a lunar flirtation is more commonly known as a total eclipse of the sun. That is to say, the moon travels in a direct line between the sun and the earth and so close to the earth that it completely covers the sun. The result is that the umbra, or the moon's dunce cap, makes a great shadow path which moves at the rate of two thousand miles or more an hour across the surface of the earth.

To an observer stationed in this path the sun is completely hidden for a very brief period varying from a fraction of a second to nearly eight minutes.

The average duration of the "total phase" is about three minutes, so that the whole time consumed in a century throughout the world could be computed in hours. Making allowances for bad weather, unfavorable time of day, and inaccessible locations, it would be safe to assert that less than one full day in a hundred years is available for the observation of total eclipses. Although expeditions have gone to the ends of the earth, astronomers have been greatly handicapped in securing scientific information on account of the limited opportunity of making observations.

The width, length, and location of the shadow path—the region in which the sun is totally eclipsed—depend upon the relative distances between the earth, moon, and sun as well as the obliqueness with which the line of centers strikes the earth. It might be a mere phantom line or it might be, "under the rarest combination" of circumstances, a hundred and sixty-eight miles wide. The shadow arc might fall anywhere in the world—indeed, as a rule, the Man in the Moon is a bit shy in his attentions for he seems to favor the most inaccessible and out-of-the-way places. Sometimes, however, as on January 24, 1925, he throws discretion to the winds and boldly treats populous regions to an astronomical thrill that they will not experience again in centuries.

Only once since the occupation of Iowa by white men has a total solar eclipse been visible within the borders of this State. On Saturday, August 7, 1869, occurred an eclipse that is memorable both on account of the local interest it created and the unusual opportunities afforded for scientific observation. Not until 1999, astronomers say, will such a phenomenon again be observed in Iowa.

Beginning in the Pacific Ocean east of Japan shortly after sunrise, the shadow path swept northward in a long graceful curve to Alaska, whence it took a southeasterly direction, crossed western Canada, entered the United States in Montana, and reached the outskirts of civilization in northwestern Iowa. Passing across central and southeastern Iowa, Illinois, southern Indiana, Kentucky, Tennessee, Virginia, and North Carolina, the eclipse ended in mid-Atlantic late in the evening after having travelled nearly half way around the earth.

The United States Navy coöperated with the Coast and Geodetic Survey in sending a costly expedition to Alaska to make observations. Numerous parties, both private and official, representing many academic and scientific institutions, made elaborate preparations to study the eclipse all along the path through the settled portion of the United States, while thousands watched the phenomenon through smoked glass or improvised telescopes. Iowa was almost ideally situated. The sun would be near the zenith at the time of the eclipse, atmospheric conditions would probably be most favorable at that time, and facilities were available for the transportation of instruments and other necessary equipment. Several prominent astronomers established temporary observatories in different parts of the State, and it was in Iowa that some of the most important scientific work was done.

The Franklin Institute of Philadelphia, coöperating with Professor J. H. C. Coffin of the United States Navy and Superintendent of the Nautical Almanac, took up headquarters at Burlington, whence small parties were sent to Mount Pleasant, Ottumwa, and Oskaloosa. This was chiefly a photographic expedition, whose principal object was to secure as many photographs as possible during the progress of the eclipse.

At Des Moines Lord Sackville A. Cecil of England collaborated with Lieutenant Commander William Harkness of the United States Naval Observatory of Washington. The Naval Observatory likewise established a station at Cedar Falls and another at St. Louis for the purpose of determining accurately the extreme northern and southern limits of totality. Professor James C. Watson of the University of Michigan was at Mount Pleasant, while at Jefferson, a party of scientists, including such famous astronomers as Sir Robert Faulkner of London, James Douglas and Commodore Ash of Montreal, and Henry Vail of Philadelphia, conducted important experiments. The purpose of working at so many different places was to avoid adverse local weather conditions if possible. The activities of the various parties were so well coördinated, however, by previous arrangements, that there was very little duplication of effort.

Professor Coffin came to Burlington several weeks before the eclipse to make preparations and determine the exact latitude and longitude of the place. The Franklin Institute party, numbering fifteen in all, were given free transportation from Philadelphia to Burlington. They brought a car load of apparatus which included two Munich equatorial telescopes of six-inch aperture equipped with clock work to move them with the sun, a Dolland four-inch telescope equatorially mounted, several spectroscopes, and considerable photographic apparatus. The larger telescopes were borrowed from Philadelphia High School and Pennsylvania College at Gettysburg, while the smaller instrument belonged to Pennsylvania University. Upon arriving at Burlington the city council extended the courtesy of the city to the "distinguished astronomers who come here to represent the United States Government." Some of the men remained in Burlington but the others proceeded to the stations farther west where they had been assigned.

On arriving at their destination the first efforts of the scientists were directed toward the selection of a suitable site for making their observations and the housing of their equipment. In some instances an advance agent did this work of reconnoitering. An elevated position was usually selected, from which the view would be unobstructed by trees or other objects, and to obviate the interference of a low-lying haze or fog during the precious moments of totality. There was also some hope that a glimpse of the fleeting shadow of the moon might be caught from the heights, by those who might have time to watch for it. Nor was an elevated position entirely necessary for the observance of the eclipse, which occurred in mid-afternoon at an hour when the sun was plainly visible from almost any convenient spot. Indeed, in Des Moines, the observatory was located on the site of the present courthouse which is on the flood plain of the Des Moines River. The eclipse stone marking the exact latitude and longitude of the spot still remains in the courthouse yard.

At Burlington a square of open ground was selected on South Hill, then owned by H. W. Starr and now included in South Hill Park. A suitable shelter for the telescopes and other paraphernalia was erected near the southwest corner of the tract. This building, which was typical of those constructed elsewhere, contained a main room ten by twelve feet in dimensions. That portion of the roof covering the telescopes was portable, so that it might be lifted off, set aside, and replaced again at the close of the day's operations. As pictures were also to be taken at this station two small dark rooms and a larger developing room were provided at one end in addition to the main room. These cramped quarters served as laboratories for the photographers, whose work in those days of wet plates was of a very exacting nature, requiring the highest type of training and skill. It was necessary to coat each plate with a special gelatine preparation, which in turn was impregnated with the silver nitrate solution, placed in the plate-holder in one dark room, passed out to the operators who exposed the plate in the camera and returned it to another dark room where it was developed, passed through the fixing bath, washed twice, flowed with glycerine, and placed in the rack to dry.

These photographic parties consisted of four or five men—one or two who prepared the plates, one who operated the camera, another who timed the exposure, and the last who operated the developing room in which the process was completed. The very highest grade of work on the part of each man was required to insure the success of the entire undertaking, as a blunder on the part of any one of them might prove disastrous. They drilled themselves in team work, so that during the eclipse they might work with the alertness and precision of a machine gun crew. So well did they coöperate that at Burlington forty-one perfect negatives were secured out of forty-two exposures made. Indeed, the darkroom operators were the heroes of the occasion. Some of them journeyed hundreds of miles at their own expense for the purpose of observing the eclipse, and returned again to their homes, scarcely having caught so much as a glimpse of the total phase of that marvelous phenomenon, except for that which came to them through the medium of the precious sensitized plates with the development of which they were intrusted.

Miss Maria Mitchell, a noted astronomer of Vassar College, brought to Burlington a class of eight girls interested in the eclipse. Dressed in the height of fashion, with their wide hoop skirts and tiny parasols, and schooled in ladylike demeanor, they lent a touch of romance to the occasion. No doubt they won the admiration of the young gallants of Burlington and became objects of envy on the part of neglected local maids.

At Jefferson, several days were employed in making a minute topographical survey of the vicinity before a site was selected east of the old fair grounds, on a hilltop beyond what is now the north end of Chestnut Street. The observatory building in Ottumwa was erected on a high prominence in a plot proffered by John Devans. For years thereafter the place was known locally as "Observatory Hill", in the High Point vicinity.

At Oskaloosa a small party of scientists went out into the open country adjacent to town, keeping their instruments in a small brick dwelling a short distance west of "Oskaloosa College," while another local party viewed the eclipse from the roof of a new three-story skyscraper which had just been completed at the northwest corner of the public square.

It is not known for certain just where the main parties were located in Mount Pleasant. Some of the visitors stayed at the home of their old friend, J. H. Whiting, at the corner of Lincoln and Henry streets, and made use of the flat deck roof of his dwelling for their instruments. Prof. E. C. Pickering, of the Massachusetts Institute of Technology, connected with the party sent out by the Nautical Almanac, conducted his experiments from the corner room on the third floor of the four-story Brazelton House which afforded an unobstructed view to the west. On the roof above, astronomers labored at one corner, while at another place sat a small group of religious fanatics, "arrayed in their ascension robes of spotless white", silently awaiting the end of the world.

At Cedar Falls observations were in charge of Dr. Asa Horr, of Dubuque, President of the Iowa Institute of Science and Arts, assisted by Wm. I. Anderson and W. W. Wormood. As the object of this party was to determine the extreme northern limit of totality, a line perpendicular to the path of the eclipse was established with the greatest of care, passing through the cupola of the old Soldiers' Orphans' Home. Using this cupola as a starting point, competent observers were stationed at intervals of one-half mile in both directions. It was their duty to obtain the exact duration of totality in seconds, by means of a stop watch. Thus the approximate dividing line between the total and partial phase of the eclipse could be determined.

W. S. Gilman, of New York, equipped with a four-inch telescope, made observations for the Washington naval observatory at St. Paul Junction, near Sioux City. At Cherokee, J. Blickensderfer took amateur time observations with unusual care, using a telescope with a three and three-tenths inch aperture. William Pilger of Burlington, still residing at 715 Elm Street in 1925, used to advantage a two-inch telescope on North Hill. In Linn County J. W. McClellan, superintendent of the public schools at Marion, made some valuable investigations on his own responsibility, toward ascertaining the north line of totality. He determined that this line ran diagonally through section 16, township 85, range 6, west of the Fifth Principal Meridian.

In every community and at almost every fireside for weeks in advance the coming eclipse was a common topic of conversation in Iowa. The event was also freely discussed in the columns of the newspapers, and much valuable information as well as some misinformation was disseminated concerning nature's free exhibition. The interest created by witnessing the eclipse started more than one young Iowan upon a career of science.

In nearly every city, groups of citizens met for the purpose of viewing the phenomenon. Such telescopes as were available were used, while field glasses and surveyor's instruments were likewise pressed into service. Many watched the eclipse with the aid of a piece of colored glass, amber or violet being commonly employed, while the "rank and file" used only a smoked glass made by coating a fragment of broken window pane with the soot from a lighted candle or the flame of a kerosene lamp. These makeshifts sufficed to shield the eye from the intense light of the sun, and in fact afforded the observer about as good a view of the eclipse as might have been obtained with more elaborate paraphernalia.

At Keokuk many house-top parties assembled to witness the eclipse; an especially notable one taking advantage of the broad roof of the Estes House, while at least one group went far afield to secure a suitable hill for their observations. Like distant pastures, each hill beyond seemed a little higher, and so the party strayed on and on through "fields of fragrant clover" until the eclipse was upon them before they realized it. Without a moment's delay they were compelled to set up their instruments hastily upon the spot where they were, having passed many superior locations.

While the eclipse was in progress the sky changed from its usual azure to a livid purple or violet tint. "The color of the surrounding objects", one authority stated, became "yellowish or of a light olive or greenish tinge", and the figures of persons assumed an "unearthly cadaverous aspect". The reflections of the sun falling through the leaves and branches of the trees upon the ground or upon the sides of buildings, changed gradually from their usual circular form to the shape of the crescent, caused by the moon overlapping the sun. As the eclipse advanced, a marked decrease in temperature was noticed. At Des Moines a drop of 13° Fahrenheit was registered by J. R. Eastman and at Mount Pleasant the temperature fell from 40.8° centigrade to 24.7° centigrade, while at Cedar Falls a light dew was precipitated as a result of the cooling of the atmosphere. Just before the moment of totality strong air currents were felt—also the result of the rapid cooling of the air within the area of the shadow path.

A few minutes before obscurity, as well as at the close of the total phase, remarkable wavering "shadow bands" were observed. From an elevated position, the moon's shadow could be seen sweeping across the landscape and in an instant enveloping all in its uncanny darkness. At Keokuk, a local observer reported that he was able to discern one of the brighter stars for a period of ten minutes after the close of the total phase.

The darkness, however, was somewhat less intense than that which prevails at night in the presence of a full moon, though it appeared greater on account of the sudden transition from day to night. The twilight of the eclipse resembled but little the darkness of night. It was attended by unnatural, ubiquitous gloom tinged with green, red, or yellowish crimson. The sky in Iowa was clear and bright at the time so that no light was reflected from clouds to destroy the full effect.

At Des Moines the duration of the total phase, as registered by T. H. Safford of Dearborn Observatory, was two minutes and fifty-two seconds. A discrepancy of from six to twenty-two seconds was noted in the time of the various phases as calculated at Washington years in advance. A part of this difference might be accounted for by an error in securing the time, which was taken by telegraph from Springfield, Illinois.

It is safe to say that of all the phenomena of the heavens, there is none that has so engaged the attention of mankind as have solar eclipses. In ancient times, their prediction and observance was made a matter of state policy in order to operate upon the fears of the ignorant and impose upon them a superstitious regard for the occult wisdom of their rulers. Even among civilized and enlightened people a total eclipse of the sun is an awe-inspiring spectacle, capable of filling all who are privileged to witness it with a feeling of wonder and foreboding. In this respect the eclipse of 1869 was no exception to the rule, particularly in rural or frontier communities such as Iowa.

Live stock early sensed the approach of the eclipse, and the cattle went bellowing about in an uneasy, restless manner seeming to fear the approach of some impending danger. As the eclipse advanced, they gathered in groups as if in preparation for nightfall or made their way toward stable or shed according to their custom. Birds flocked together and, flying ceaselessly back and forth, uttered shrill calls to each other as if in conference before autumn migration. Chimney swifts, circling about their chimneys, finally dropped in one by one as for the night. Poultry also became noticeably disturbed by the weird effect of the oncoming darkness. Old hens ran about frantically, clucking their alarm to their distracted chicks, and gathered their broods under their wings as if making ready for the unexpected night. Chickens, turkeys, and other barnyard fowl sought their roosts, wondering no doubt who moved up the clock and compelled them to go to bed on half empty gizzards. In some instances dogs, creeping close to their masters, barked or howled pitifully. Finally, as darkness advanced and the temperature fell, the chirp of the crickets added to the weirdness of the scene and the call of the whip-poor-will came from the distant woodland.

Fifty years earlier in Iowa the eclipse of 1869 would have witnessed naked savages dancing in circles, furiously beating their tom toms, shooting burning arrows at the great, open-mouthed dragon about to devour their sun, or chanting incantations imploring the intercession of the Great Spirit. Instead, it is alleged, strong, rugged, self-relying, often blasphemous pioneer men suddenly became reverent. Some of the women of more timid nature became hysterical, while crying children tugged frantically at their mothers' aprons. Older children in the country, who were playing or gathering berries in the timber, ran "straight for home", stopping neither for rail fences, bushes, nor creeks in their haste to reach a haven of refuge, while the "town kids", more sophisticated than their country cousins, exhibited great hilarity, emulating in their vociferous yelling the cheers of their elders on the house tops.

The occasion was not without its humorous aspect and many amusing incidents are told. A corpulent old colored mammy seen running up an alley toward her home in a very disheveled condition was asked where she was going in such haste. She paused long enough to shout, "The good Lord hab' sent fo' us an' I'se a gwi'an." An observer at Mount Pleasant narrates the case of a man who went about town for days beforehand, denouncing the impiety of the scientific preparations, asserting that the astronomers were profanely attempting "to pry into God's secrets", and that He had "veiled His sun in order to baffle them". The cloudy weather which continued up to the day of the eclipse seemed to give some support to his opinion, but, notwithstanding his declaration that "God would keep His rain a-going" and prevent the use of their "irreligious telescopes", the day was perfectly clear. Another local prophet announced that "the eclipse was a judgment upon the world for its abominations, and that the path of its shadow over the earth would be marked by utter blight."

The eclipse made a deep impression on those who viewed it. Important family events were often spoken of as occurring so long before or after the great eclipse. Only a few, perhaps, of those who witnessed the event remember the exact date, or even the year, but nine out of ten in speaking of the subject begin by saying, "That was the time when the chickens went to roost". Of all the impressions associated with the eclipse, that was the one thing most indelibly stamped upon their memories.

The eclipse of 1869 is chiefly noteworthy for the scientific discoveries that were made. Conditions for observation were almost ideal in Iowa. The sky was clear and totality occurred in the afternoon when the sun was in a very desirable position. Photography, crude as it was, probably contributed most in revealing new information to physicists, astronomers, and chemists. The Hover Brothers of Mount Pleasant working under the direction of Professor Pickering, J. C. Browne and W. J. Baker at Ottumwa, and Mr. Libby of Keokuk obtained clear pictures of the corona—the first ever taken in America. Partly from these photographs and from other data it was definitely ascertained that the corona is a permanent object definitely associated with the body of the sun. The existence of coronium, a hypothetical element in the corona, was described by William Harkness at Des Moines and Professor C. A. Young at Burlington. Young also observed that the principal corona lines coincided with certain aurora "iron" lines.

At Ottumwa, the first authentic photograph of the phenomenon known as Baily's Beads was secured. This is an illusion observed just before the precise moment of totality, and is caused by the light from the narrow rim of the sun being broken into small sections by the mountains of the moon. The light, shining down the valleys of the moon, appears as a "strand of a glorious necklace of pearls".

But while the scientists were making the best of the splendid opportunities for which they had made such elaborate preparations, thousands of men and women, unconcerned with astronomical problems or the interpretation of the spectacular event, watched with reverence and fascination the obedience of the two great luminaries to the eternal laws that govern them.

BEN HUR WILSON

[Between 1923 and 1948, Ben Hur Wilson contributed 57 articles to *The Palimpsest*, ranking him eighth among the contributors to this magazine. His story on "The Eclipse of 1869" appeared in the February 1925 issue of *The Palimpsest* and was one of his early contributions. A graduate of Iowa Wesleyan, Wilson taught at the Joliet High School for many years.—The Editor]

Invasion of the Astronomers

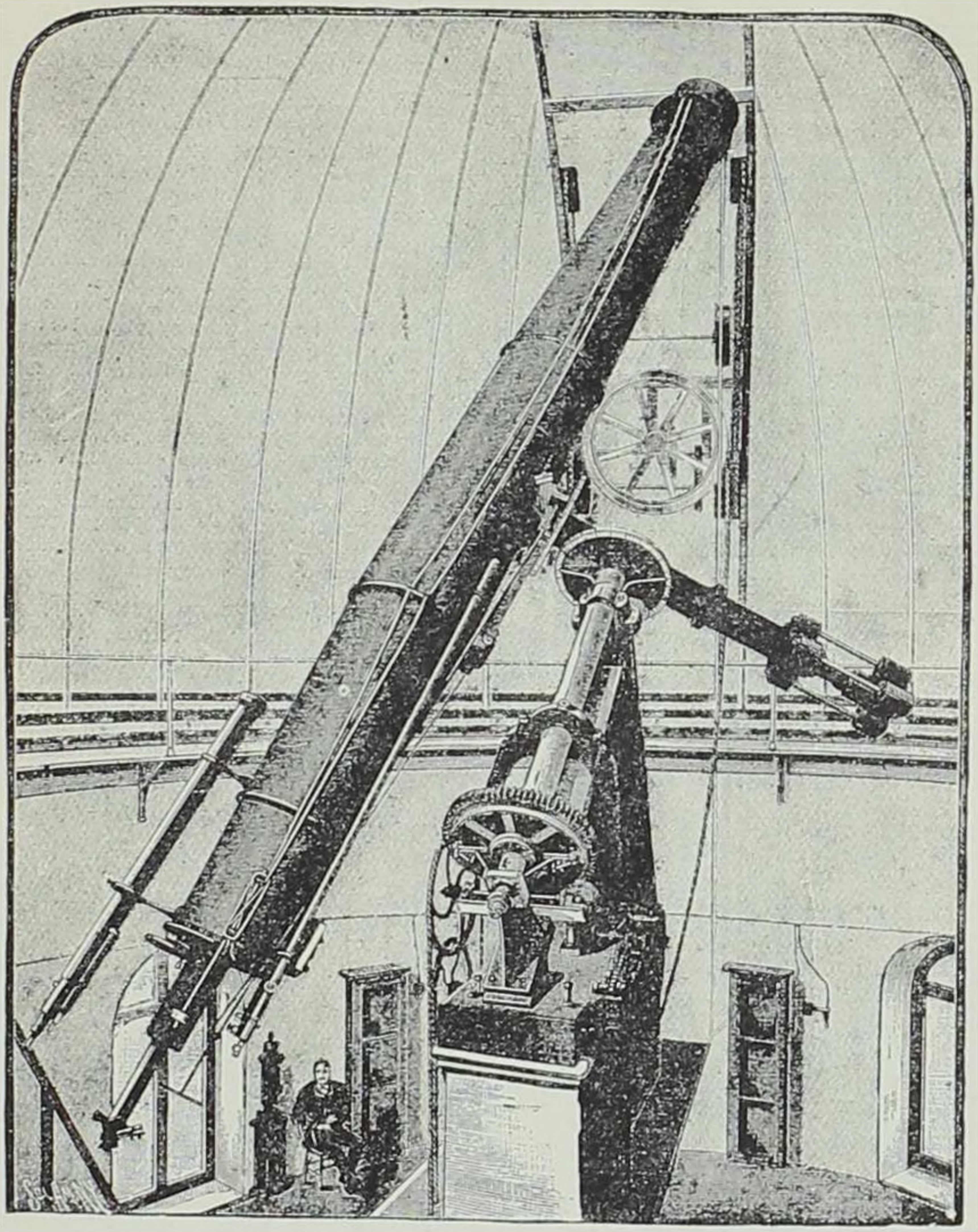
During the past decade Americans have been enthralled with the exploits of their men in space. The astronomical expenditures of the Federal Government in the space program have yielded many exciting dividends, the most spectacular of which culminated in 1969 with American astronauts twice landing on the moon. A generation ago such a feat would have seemed impossible; today we appear to be on the threshold of further magnificent achievements.

Of all the heavenly bodies, the moon has been best-known to mankind since long before the birth of Christ. The Chinese boast of their astronomical discoveries; they hold the first record of an eclipse of the sun in 2128 B.C. They apparently took their eclipses seriously for one Chinese emperor is said to have put to death his chief astronomers, Ho and Hi, for presumably getting drunk and failing to announce the solar eclipse of 2169 B. C.

The Chaldean priests were astronomers whose temples are said to have served as observatories. When Alexander the Great took Babylon in 331 B. C., he found records of their celestial observations dating back nineteen centuries. The principal early astronomical book, called the *Illumination of Bel,* was compiled for the library of Sargan of Akbad (2750 B.C.). Although the Asiatics were patient observers, they did not classify their knowledge, hence astronomers did not profit as much as they might otherwise have done from their discoveries.

It remained for western minds, especially the ancient Greeks, to classify and bring astronomical information together. Thus, Thales, one of the seven sages of Greece (640 to 548 B.C.), has been styled the "Father of Astronomy." Thales taught that the earth was round and that the moon received her light from the sun. He predicted an eclipse of the sun during a war between the Medes and Lydians. These nations, according to Herodotus, were engaged in deadly combat when an eclipse of the sun darkened the battlefield causing both sides to throw down their arms in terror and make peace. Anaximander, inventor of the sun-dial; Pythagoras, who conceived a system of the universe; and Hipparchus, the greatest astronomer of antiquity, were other early Greeks who attained fame as astronomers.

The Egyptians were also noted for their scientific minds. Their celebrated school at Alexandria attracted students from other nations, including Ptolemy, whose *Almagest* remained for fourteen centuries the text-book of astronomers. Tycho Brahe, Copernicus, Kepler, Galileo, and



The 23-inch Princeton Telescope.

PICTURES DERIVED FROM FOLLOWING SOURCES

Chambers, George F., *The Story of Eclipses,* (New York, 1903).

Report of Professor McClune on the Solar Eclipse of August 7, 1869, (Philadelphia, 1869).

Steele, Joel Dorman, *New Descriptive Astronomy,* (New York, 1869 and 1884).

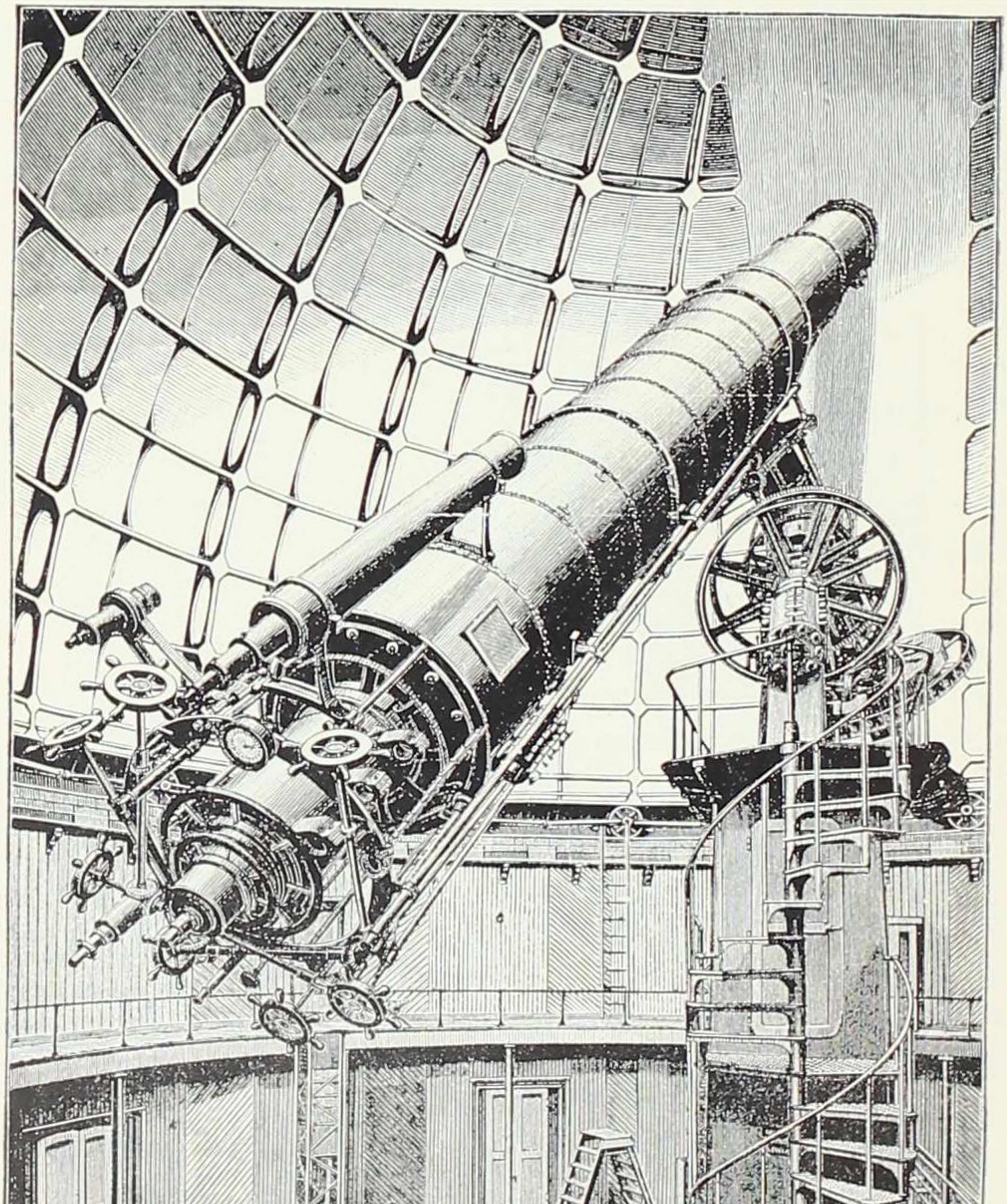
Young, Charles A., *A Text-Book of General Astronomy,* (Boston, 1900). The first nine pages of illustrations are from this text.

Pages 10 to 13 are from Chambers and Steele, listed above.

Pages 14 and 15 are loaned by the State Department of History and Archives.

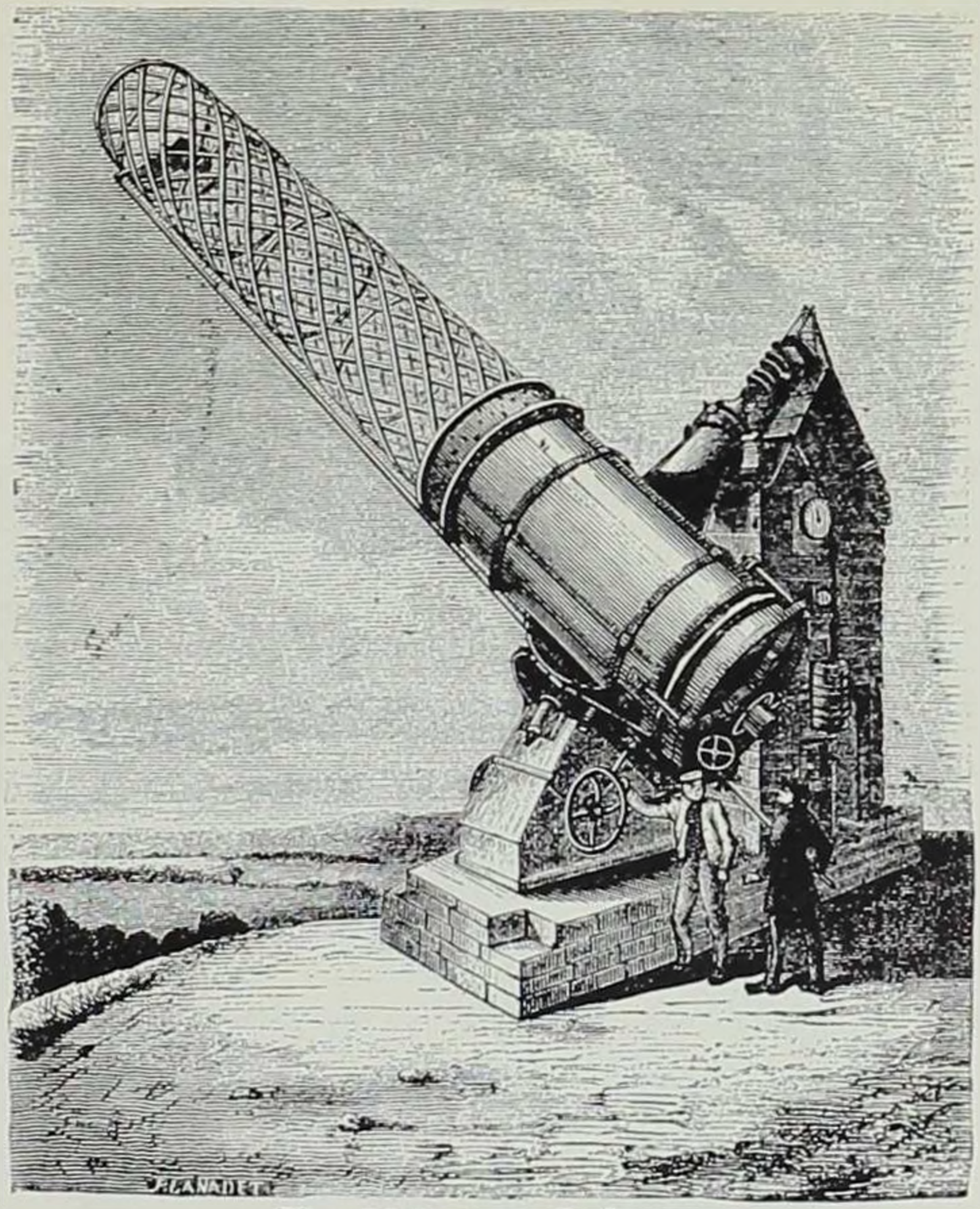
The front and back cover, and the inside back cover, are from the State Historical Society of Iowa Collections.

A Voyage to the Moon—1862 was taken from the *Iowa Homestead,* April 10, 1862.

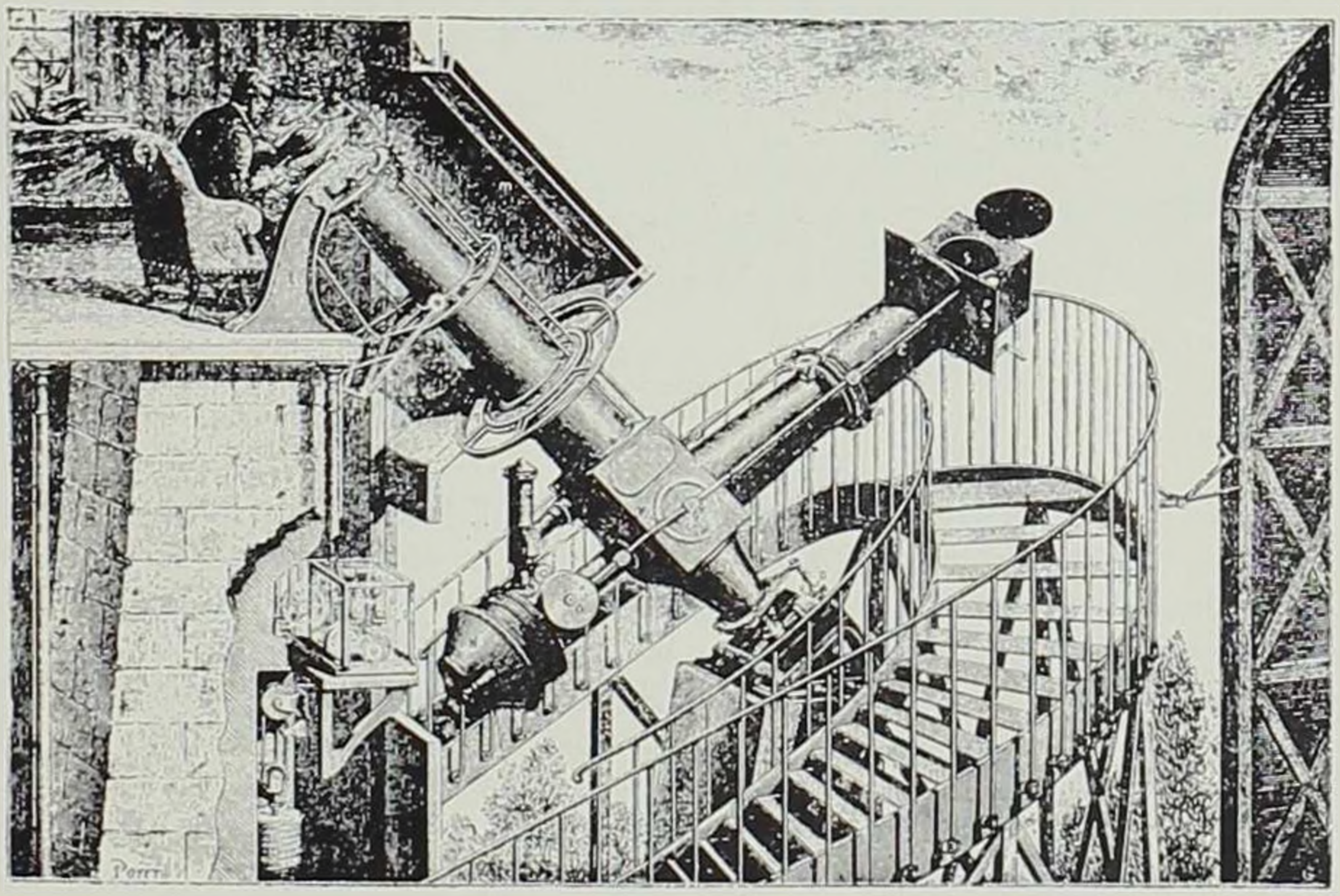


C. A. Young, *General Astronomy*

The Great Telescope of the Lick Observatory, Mt. Hamilton, Cal.
Aperture, 36 in.; Focal Length, 56 ft. 2 in.; Mounting by Warner & Swasey.



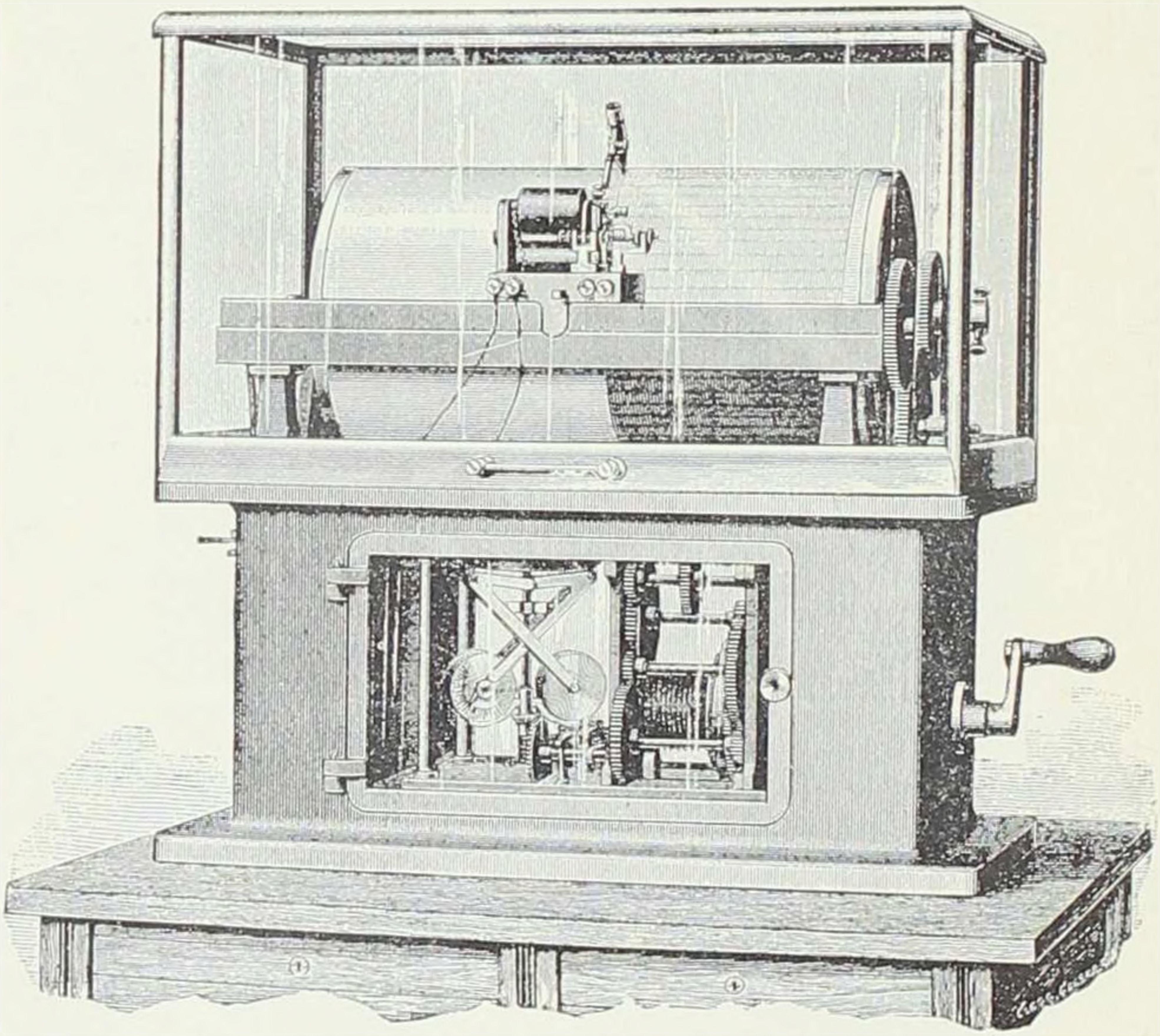
The Melbourne Reflector



The Equatorial Coude

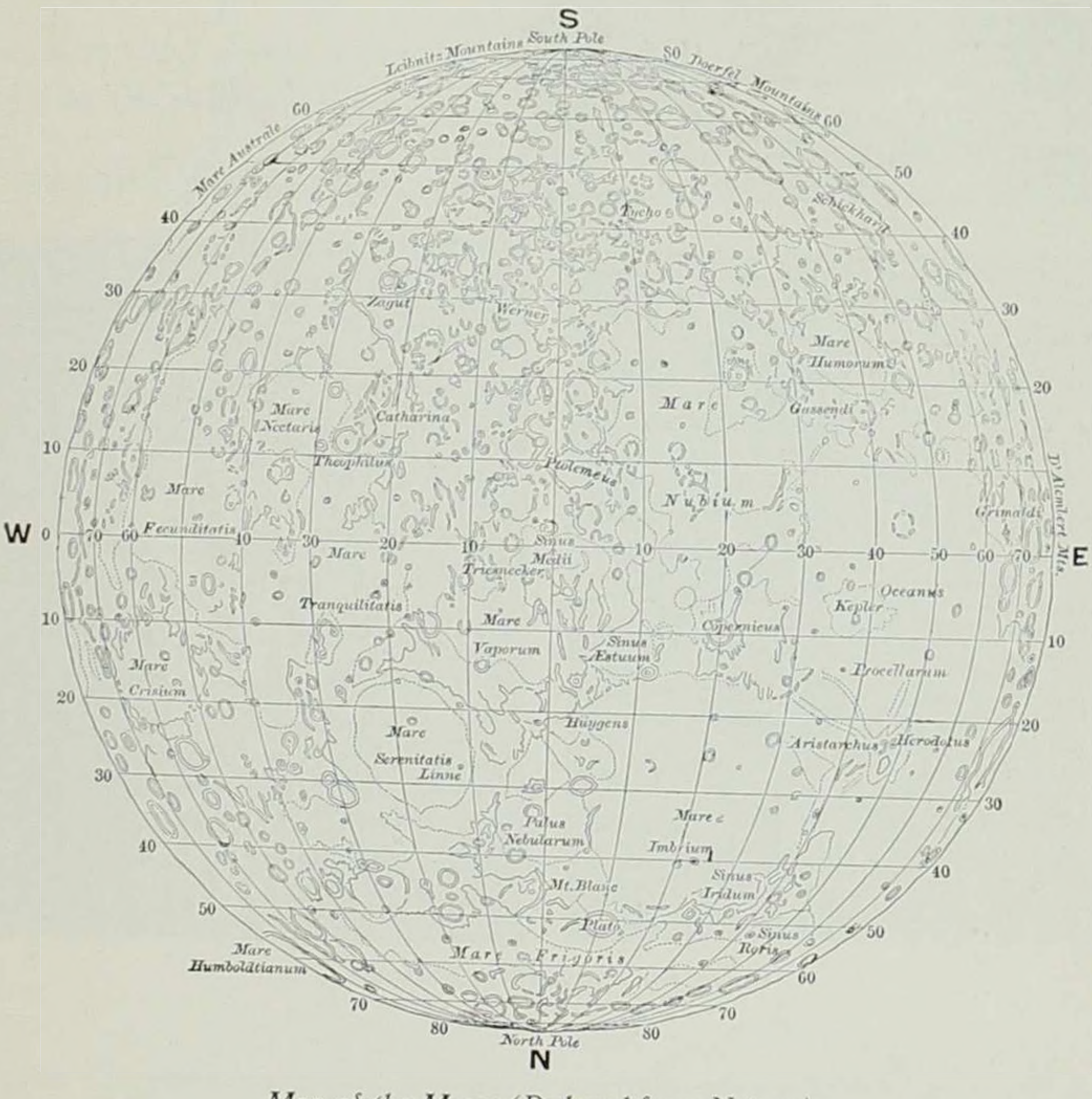
With large instruments of the ordinary form a great deal of inconvenience is encountered by the observer, in moving about to follow the eye-piece into the various positions into which it is forced by the inconsiderateness of the heavenly bodies. Moreover, the revolving dome, which is usually erected to shelter a great telescope, is an exceedingly cumbrous and expensive affair.

In the Equatorial Coude these difficulties were overcome by the use of mirrors. The observer sits always in one fixed position, looking obliquely down through the polar axis, which is also the telescope tube.



A Chronograph by Warner & Swasey

This is an instrument which carries the marking-pen and moves the paper on which the time-record is made. The paper is wrapped upon a cylinder, six or seven inches in diameter, and fifteen or sixteen inches long. This cylinder is made to revolve once a minute, by clock-work, while the pen rests lightly upon the paper and is slowly drawn along by a screw-motion, so that it marks a continuous spiral.



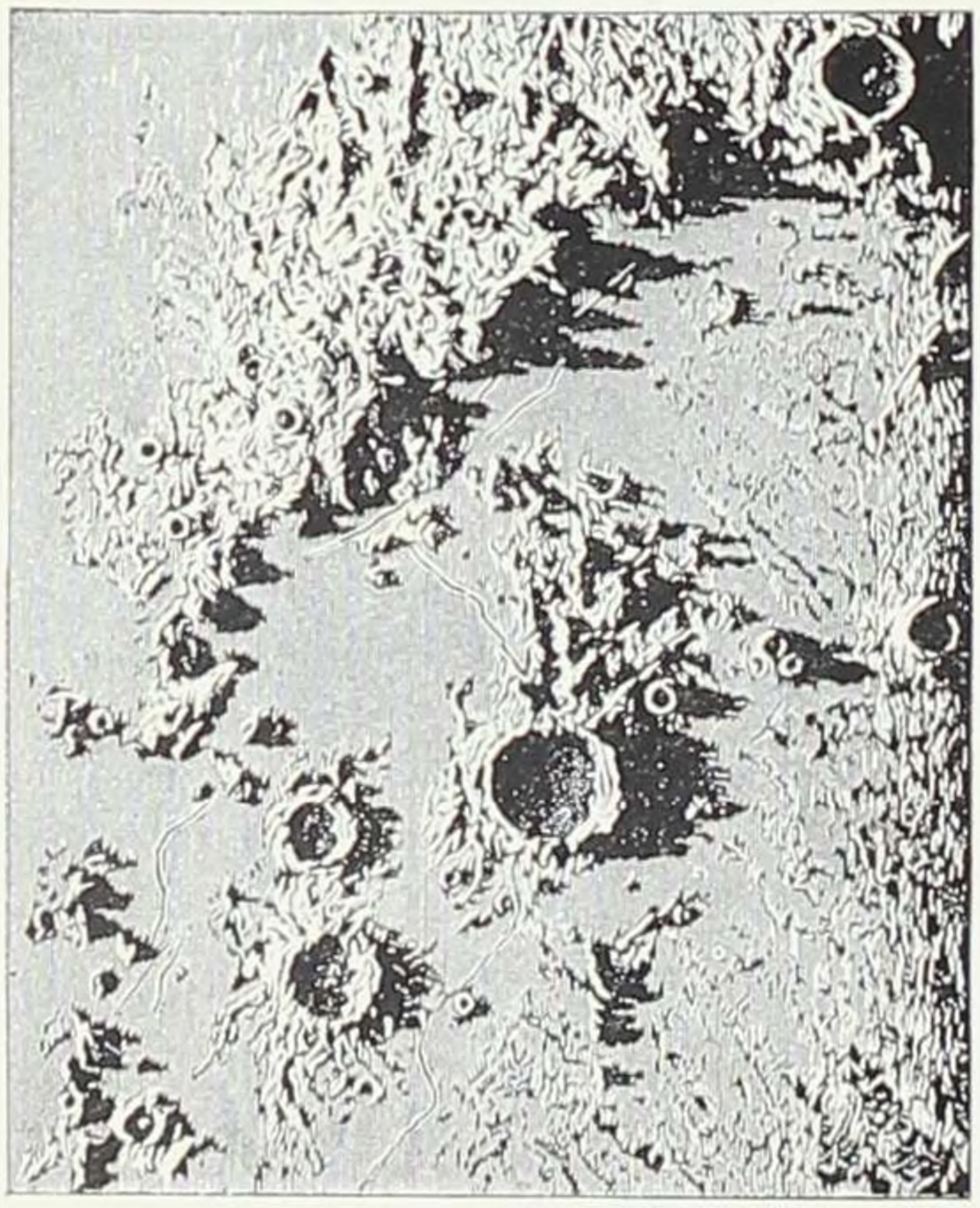
Map of the Moon (Reduced from Neison)

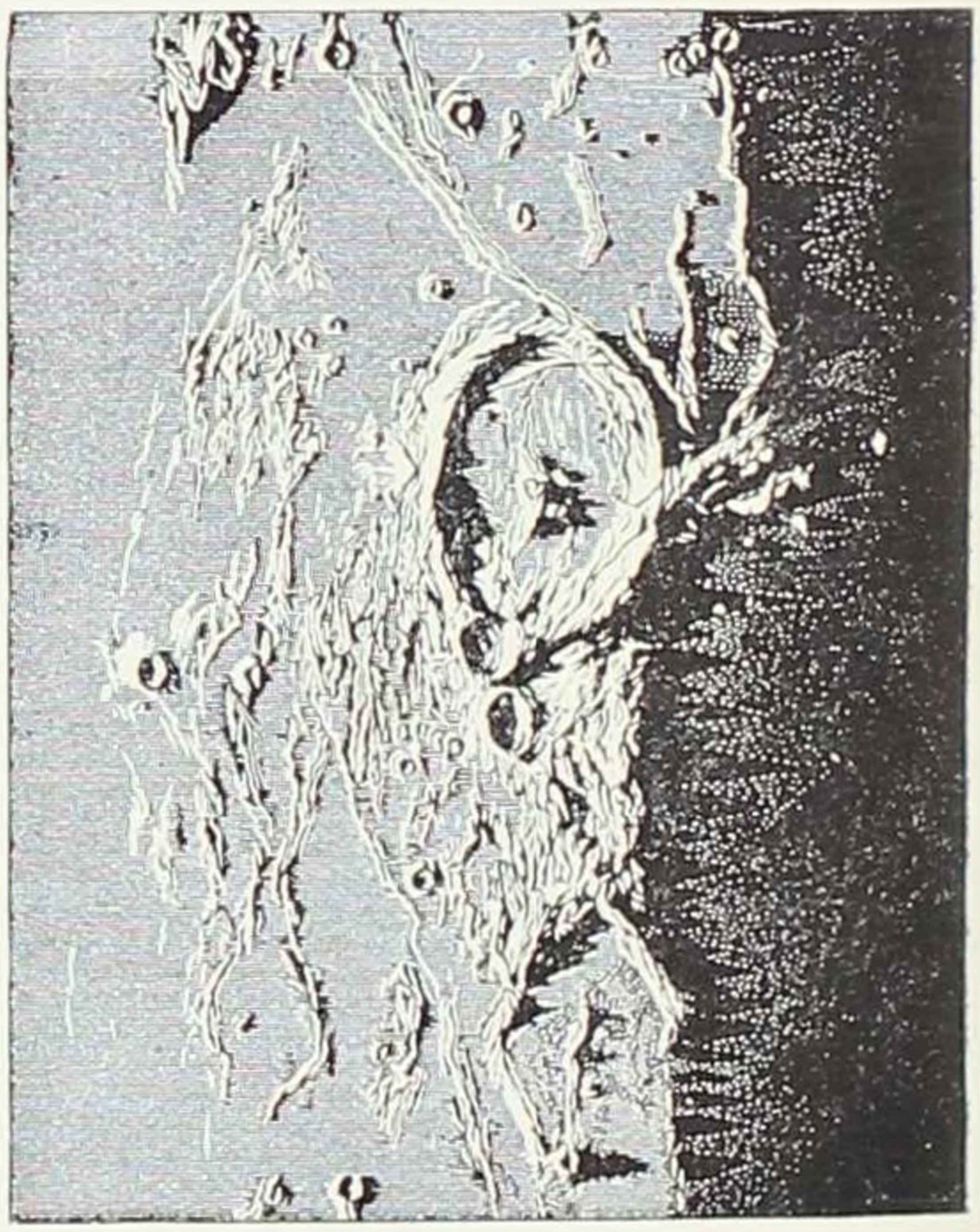
The great plains were called by Galileo oceans or seas (Maria), and some of the smaller ones marshes (Paludes) and lakes, for he supposed that the grayish surfaces visible to the naked eye, and conspicuous in a small telescope, were covered with water. Thus we have the "Oceanus Procellarum," the "Mare Imbrium," and a number of other "seas," of which "Mare Fecunditatis," "Mare Serenitatis," and "Mare Tranquilitatis," are the most conspicuous. There are twelve of them in all, and eight or nine Paludes, Lacus, and Sinus.

(Opposite) A Normal Lunar Crater.

(Below, left) Archimedes and the Apennines.

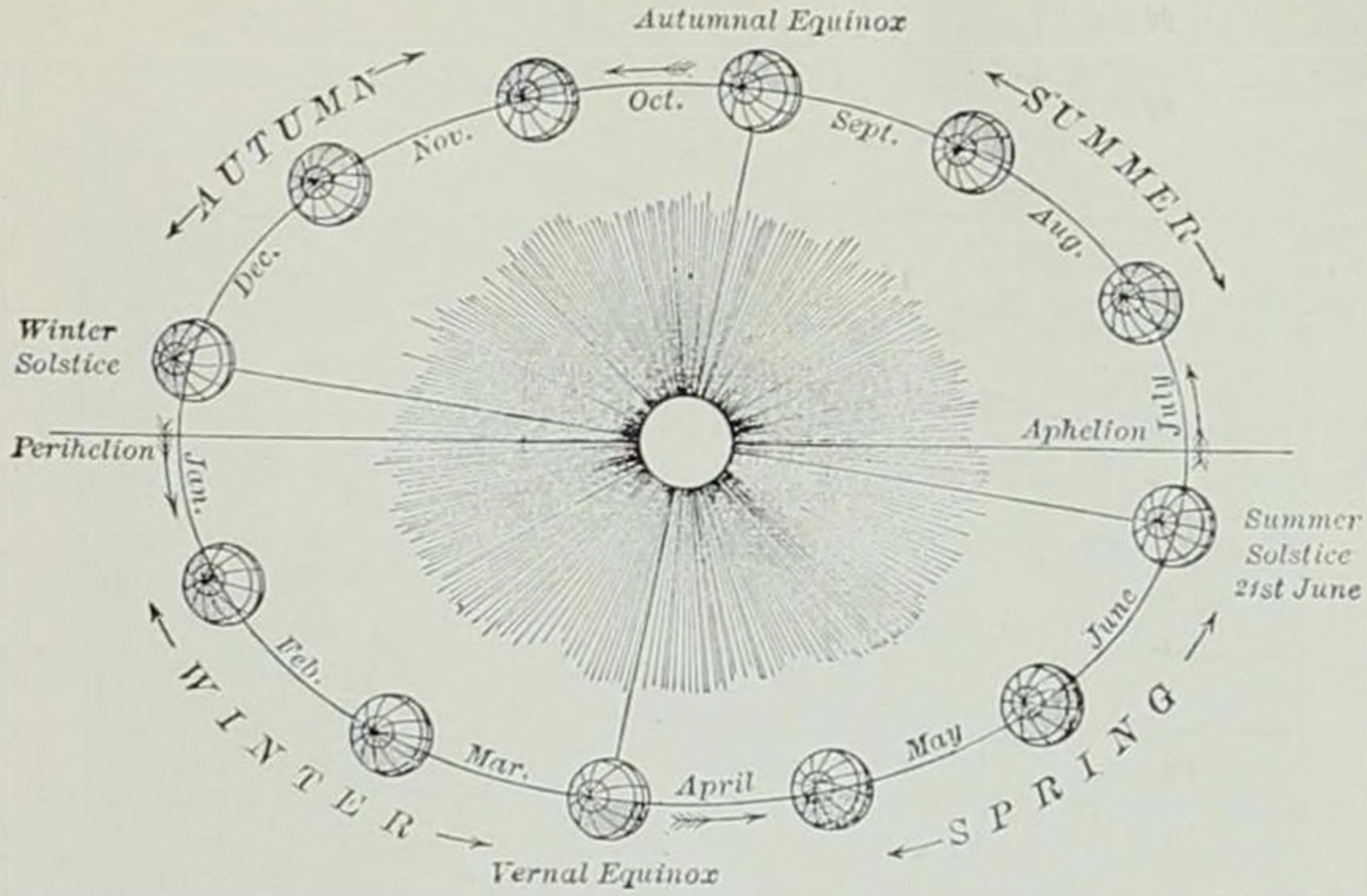
(Below, right) Gassendi (Nasmyth).





The Moon's Surface Structure

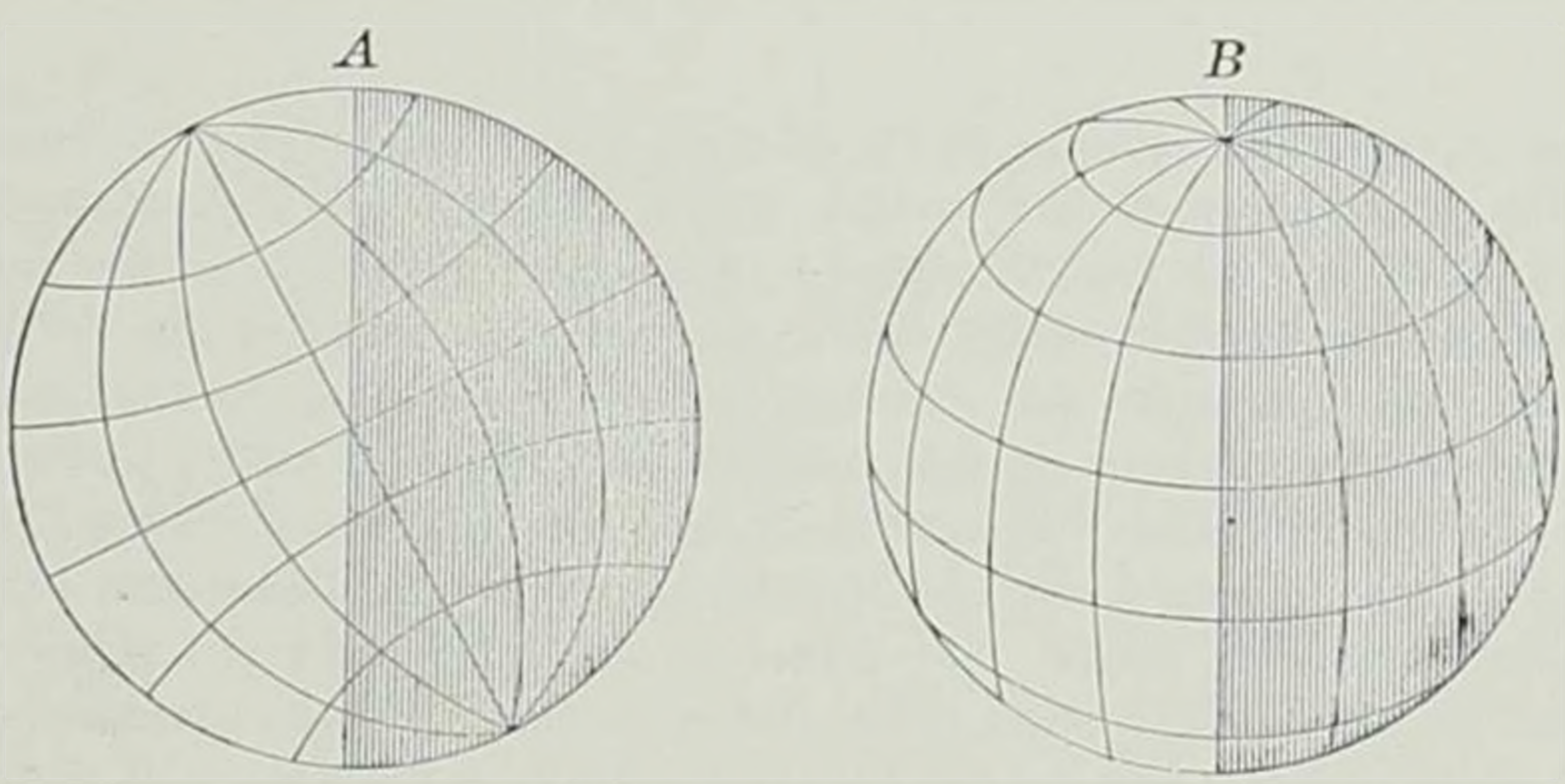
The moon's surface for the most part is extremely uneven and broken, far more so than that of the earth. The structure, however, is not like that of the earth's surface. On the earth the mountains are mostly in long ranges, such as the Alps, the Andes, and Himalayas. On the moon such mountain ranges are few in number, though they exist; but the surface is pitted all over with great craters, resembling very closely the volcanic craters on the earth's surface, though on an immensely greater scale. . . . The normal lunar crater is nearly circular, surrounded by an elevated ring of mountains which rise anywhere from 1,000 to 20,000 feet above the surrounding country. Within the floor of the crater the surface may be either above or below the outside level. Some craters are deep, some filled nearly to the brim. . . . On some portions of the moon these craters stand very thickly. Older craters have been encroached upon, or more or less completely obliterated by the newer, and the whole surface is a chaos, of which the counterpart is hardly to be found on the earth, even in the roughest portions of the Alps. This is especially the case near the moon's south pole.



The Seasons

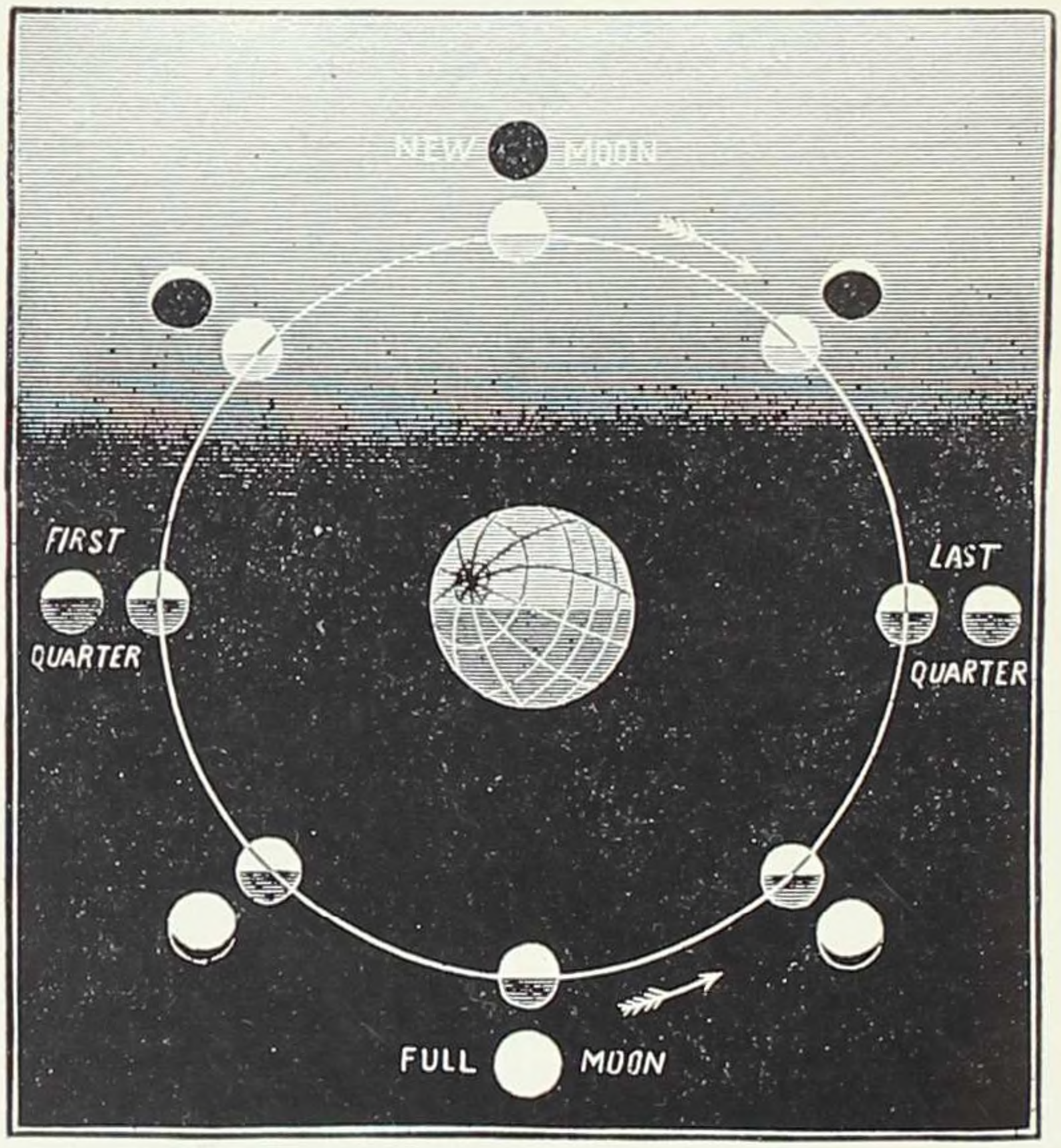
The earth in its motion around the sun always keeps its axis parallel to itself, for the mechanical reason that a revolving body necessarily maintains the direction of its axis invariable, unless disturbed by extraneous force, as is very prettily illustrated by the gyroscope. The above shows the way in which the north pole of the earth is inclined with reference to the sun at different seasons of the year.

About March 20 the earth is so situated that the plane of its equator passes through the sun, the sun's declination being zero on that day. At that time, the line which separates the illuminated portions of the earth passes through the two poles (as shown above and below), and day and night are everywhere equal. The same is again true of the 22nd of September, when the sun is at the autumnal equinox on the opposite side of the orbit.



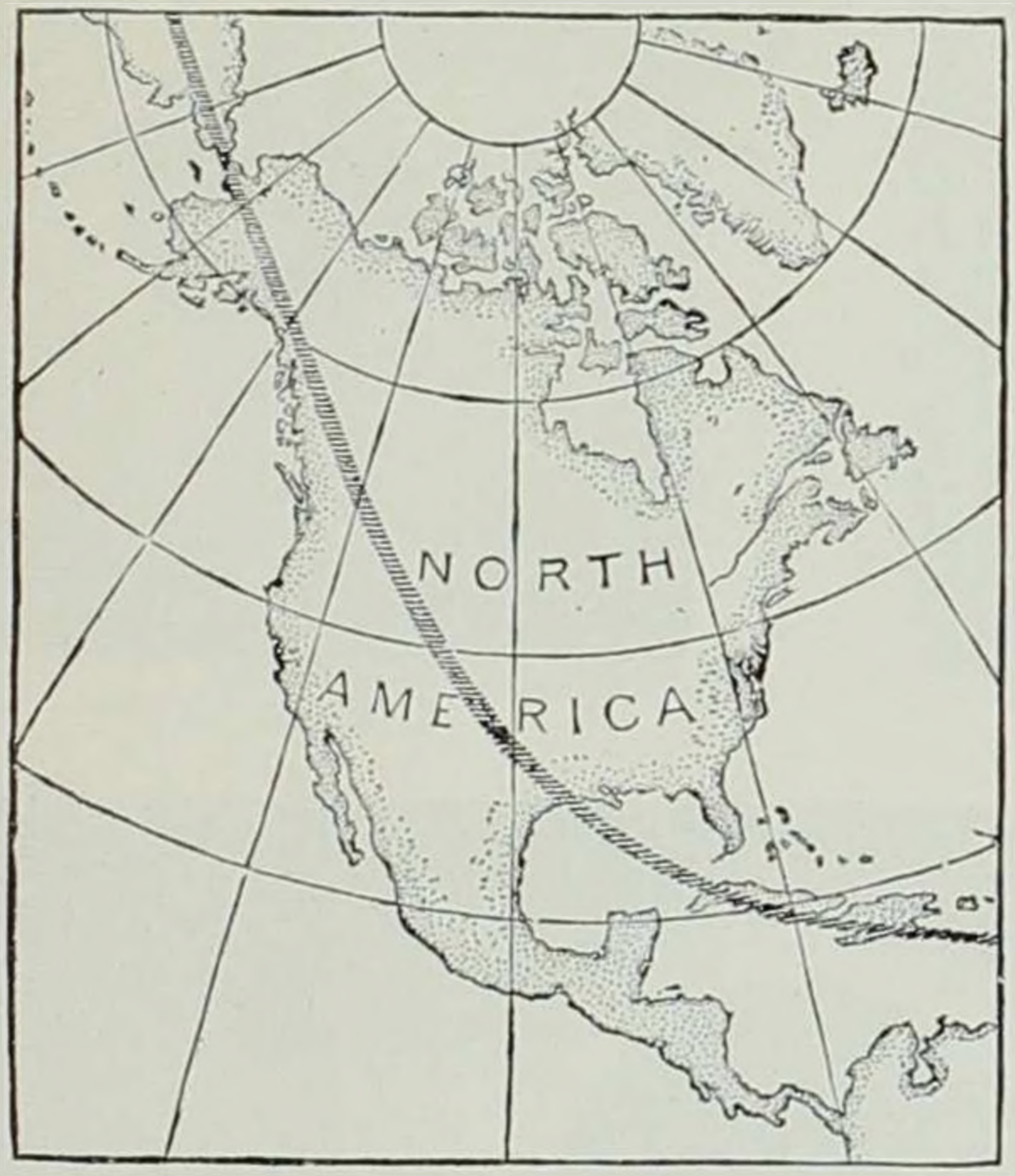
Position of Pole at Solstice and Equinox

About the 21st of June the north pole receives sunlight all day long; and in all portions of the northern hemisphere the day is longer than the night . . . while in the southern hemisphere the days are shorter than the nights.



The Phases of the Moon

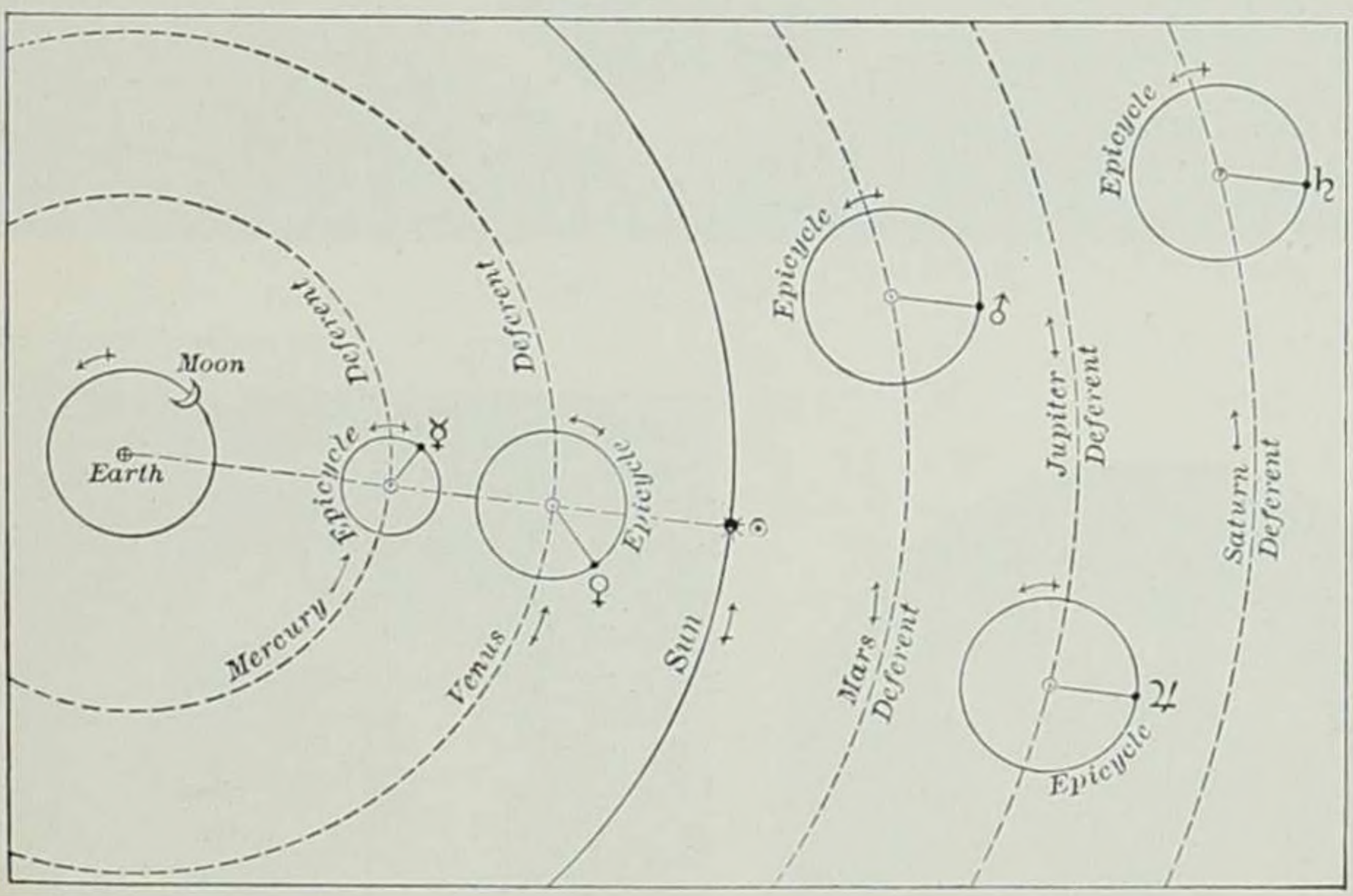
Since the moon is an opaque globe, shining entirely by reflected light, we can see only that hemisphere of her surface which happens to be illuminated, and of course only that part of the illuminated hemisphere which is at the time turned towards the earth. At new moon, when the moon is between the earth and the sun, the dark side is towards us. A week later, at the end of the first quarter, half of the illuminated hemisphere is seen, and we have the half moon, just as we do a week after the full. Between the new moon and the half moon, during the first and last quarters of the lunation, we see less than half of the illuminated portion, and then have the "crescent" phase. See above in which the light is supposed to come from a point far above the moon's orbit. Between the half moon and the full, during the second and third quarters of the lunation, we see more than half of the moon's illuminated side, and have what is called the "gibbous" phase.



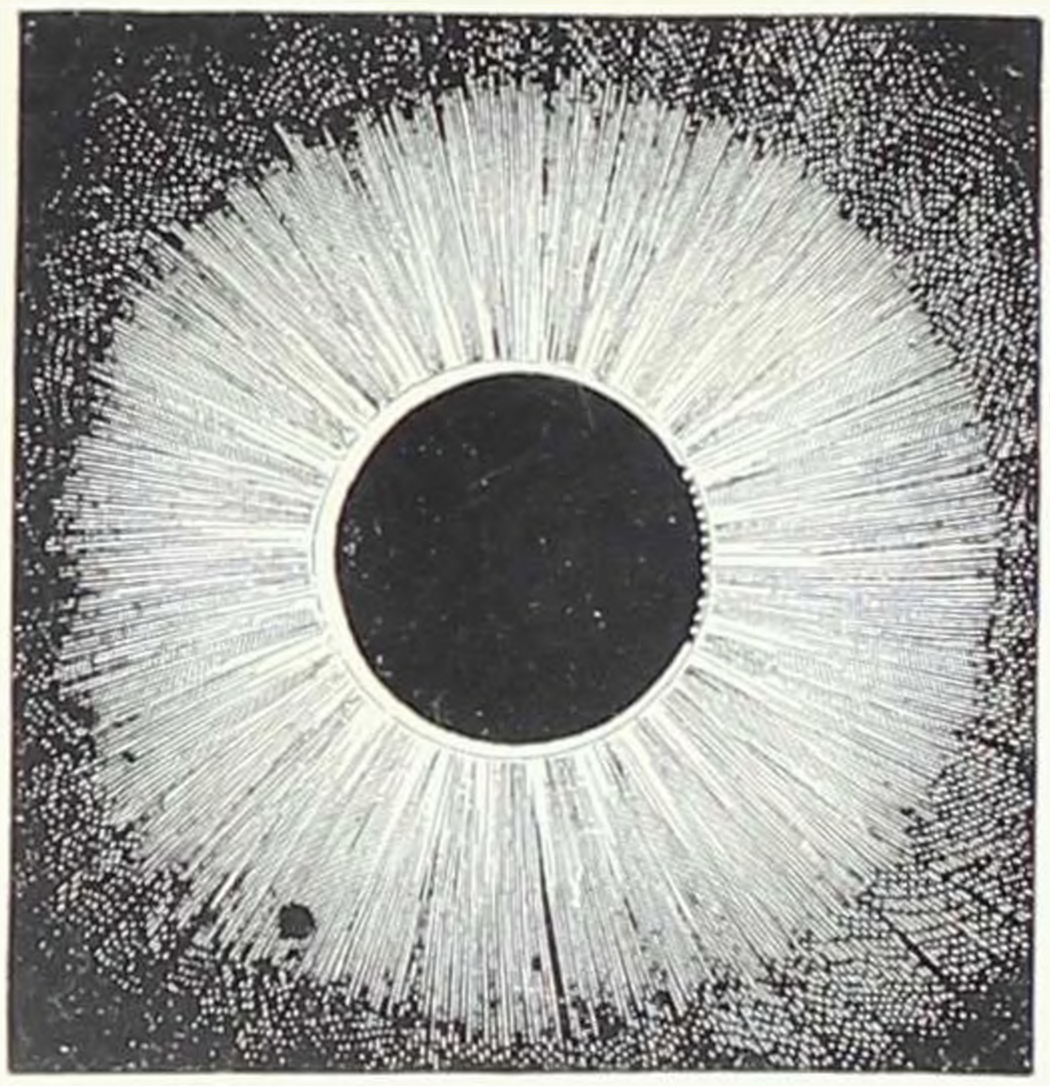
Track of the Moon's Shadow, Eclipse of July 29, 1878.

Velocity of the Shadow

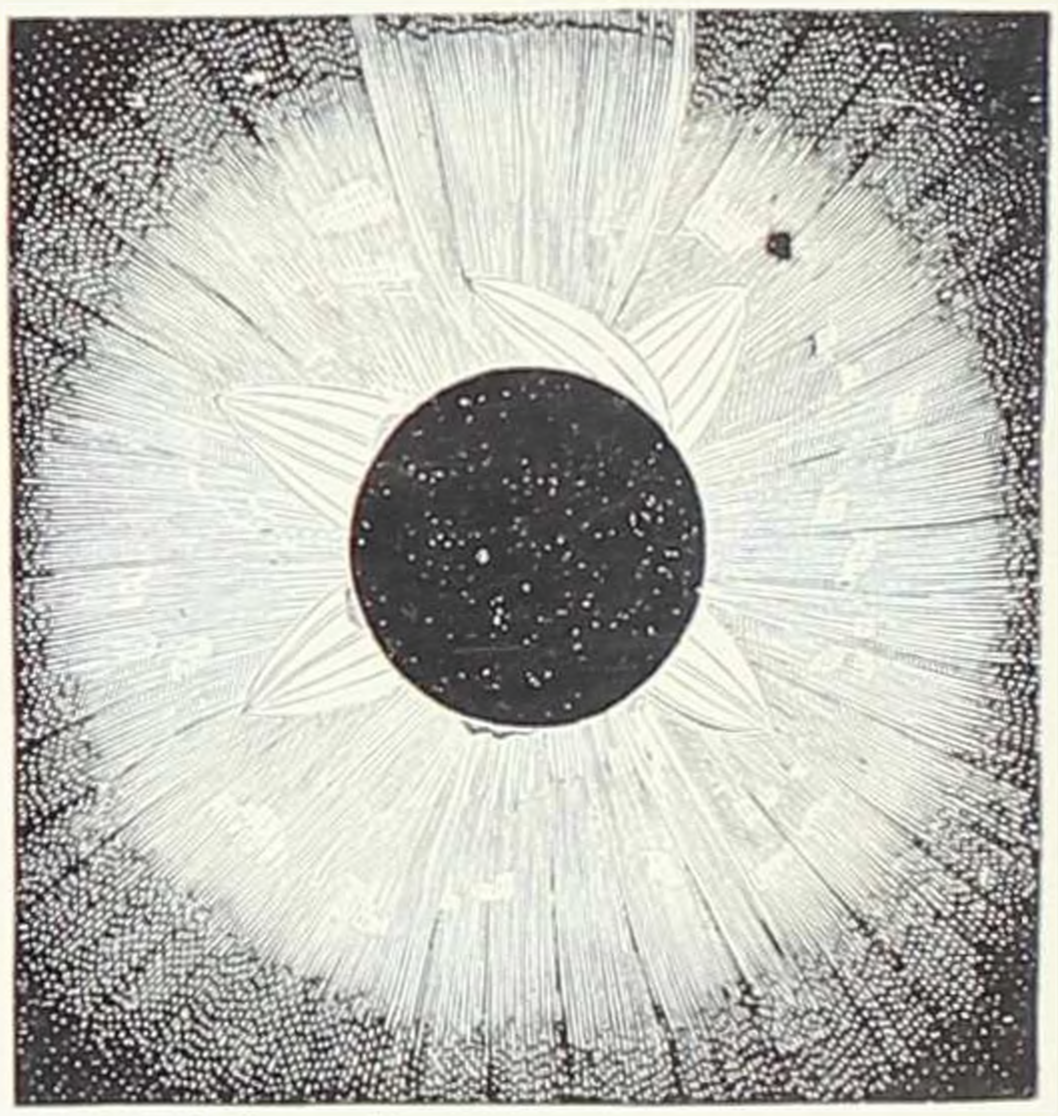
The moon advances along its orbit very nearly 2,100 miles an hour, and were it not for the earth's rotation, this is the rate at which the shadow would pass the observer. The earth, however, is rotating towards the east in the same general direction as that in which the shadow moves, and its surface moves at the rate of about 1,040 miles an hour at the equator.



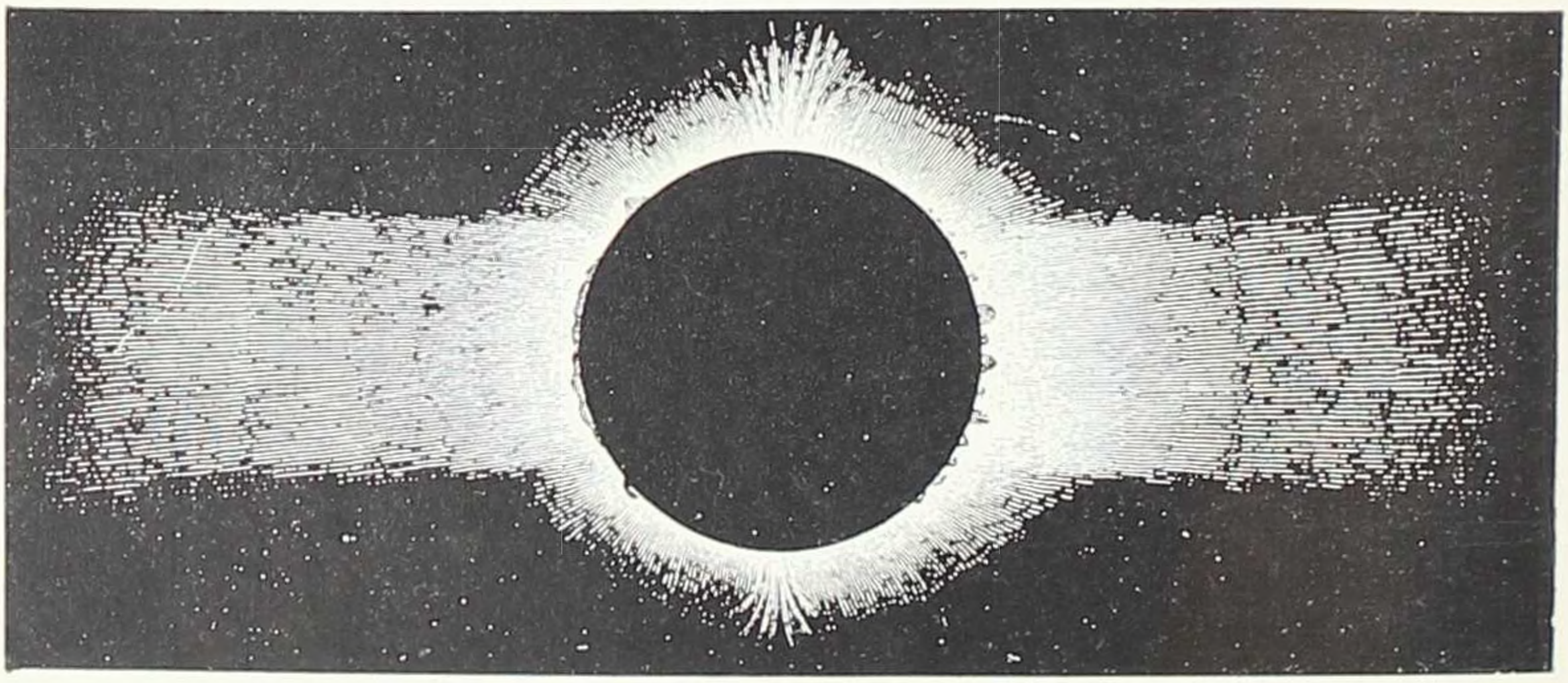
The Ptolemaic System was for fourteen centuries the authoritative "Scripture of Astronomy." It supposed that all planets moved around the circumference of a circle with the earth as the center.



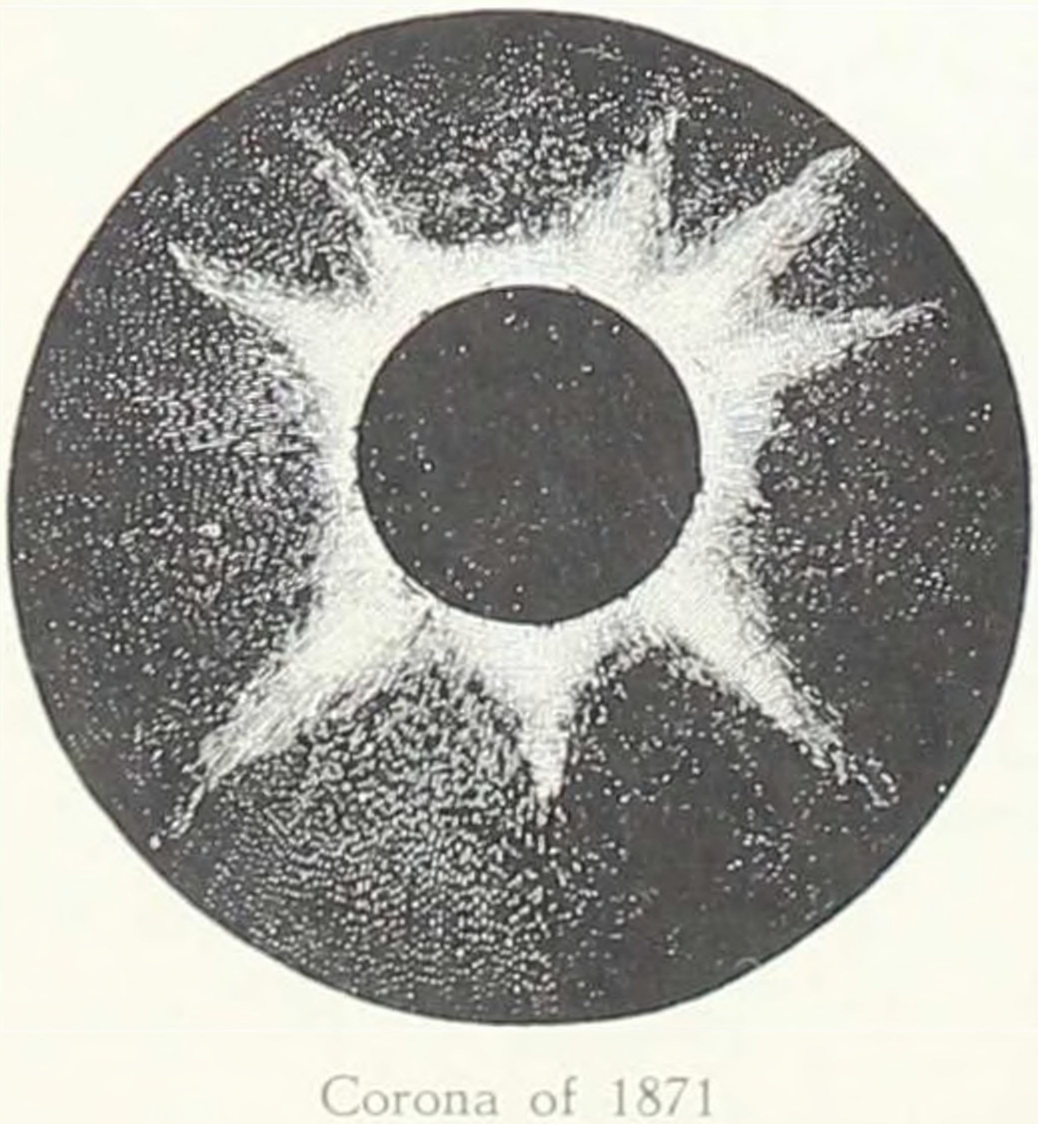
Annular Eclipse of 1835



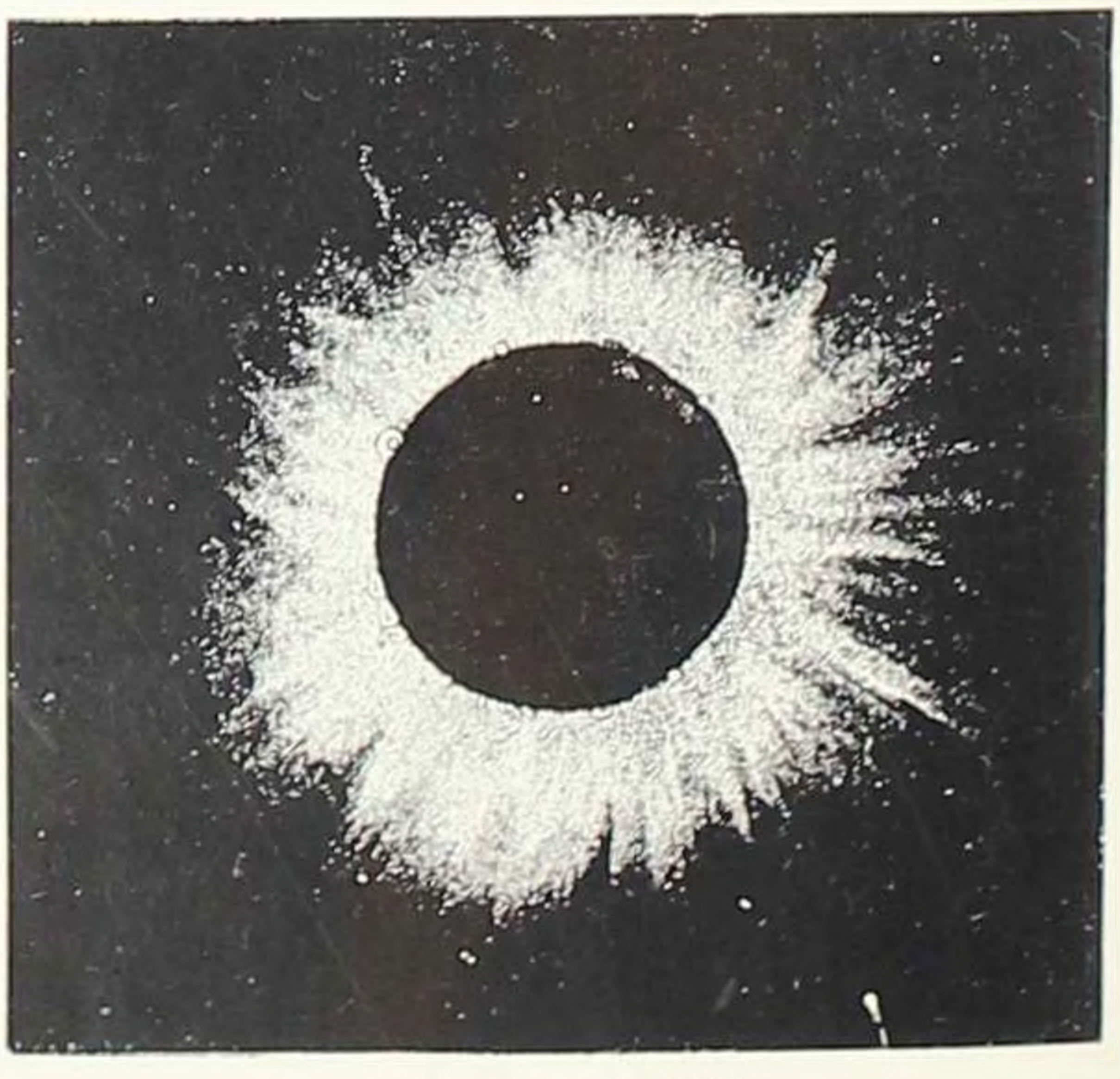
Eclipse of 1858



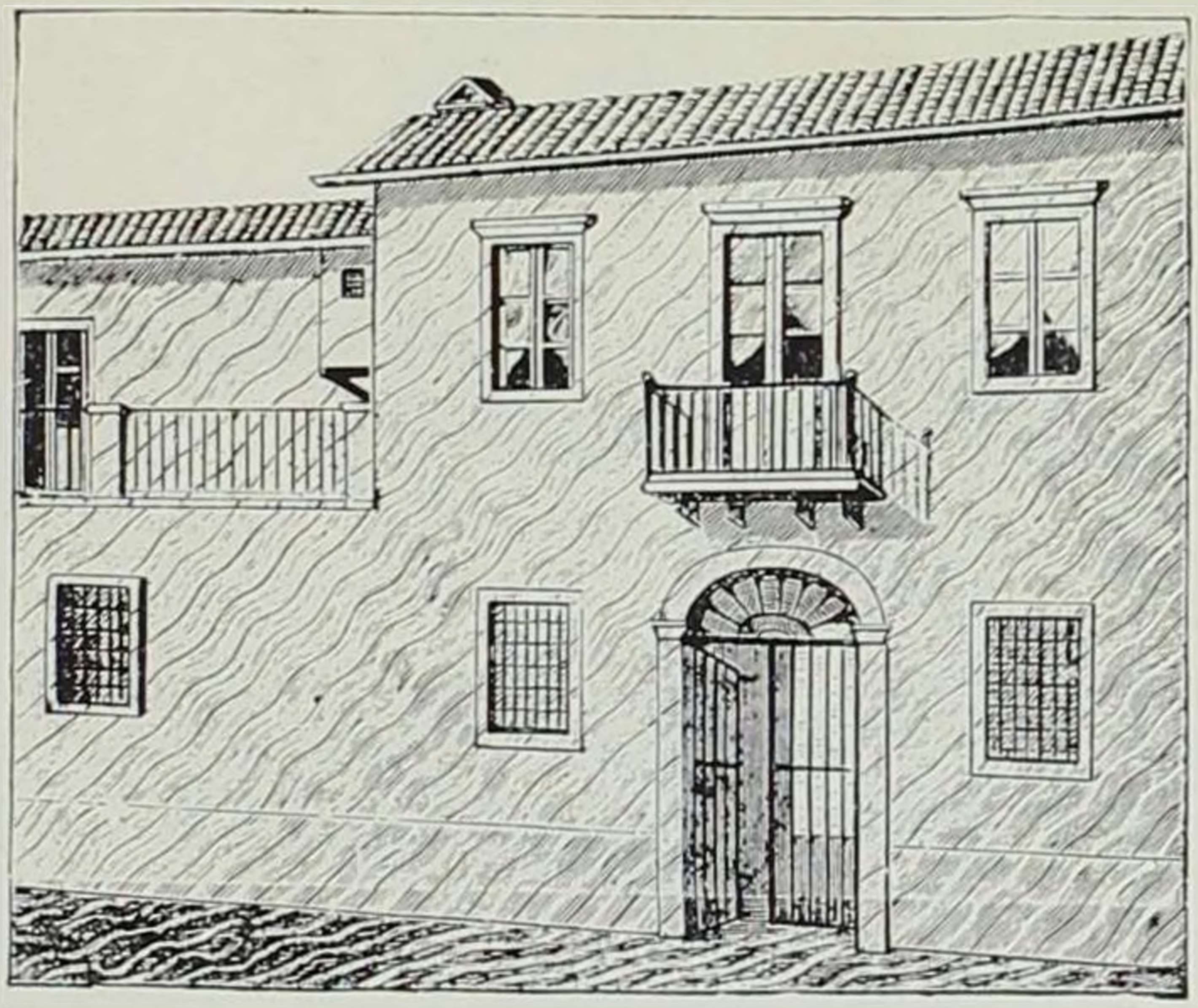
Corona of 1867



Corona of 1871



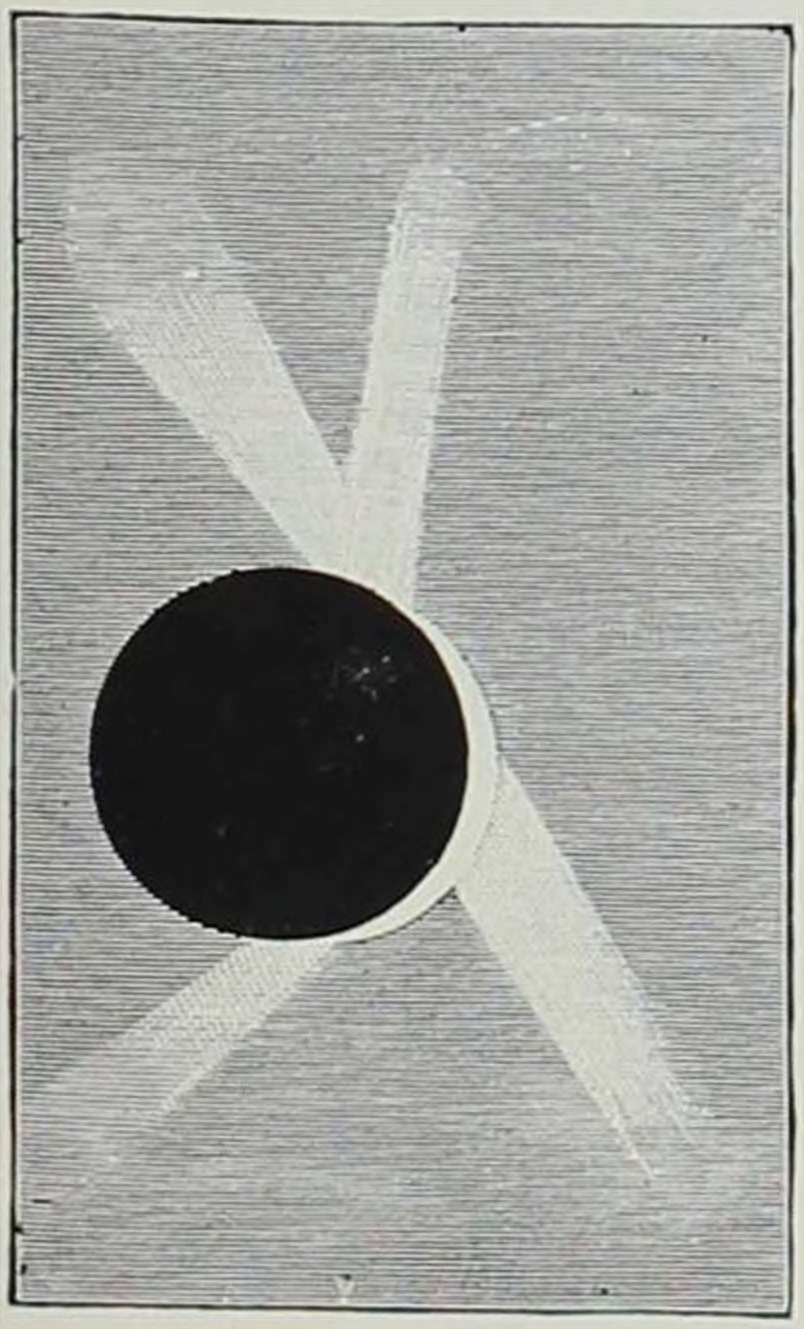
Corona of 1882



Shadow Bands

Let us suppose that we have a chance of observing a total eclipse of the Sun; have completed all our preliminary preparations; have taken note of everything which needs to be noted or suggests itself for that purpose up till nearly the grand climax; and that the clock tells us that we are within, say five minutes of totality. Somewhere about this time perhaps we shall be able to detect, dancing across the landscape, singular wavy lines of light and shade. These are the "Shadow Bands," as they are called. The phrase is curiously inexplicit, but seemingly cannot be improved upon at present because the philosophy of these appearances—their origin and the laws which regulate their visibility—are unknown, perhaps because amid the multitude of other things to think about sufficient attention has hitherto not been paid to the study of them. These shadow bands are most striking if a high plastered wall, such as the front of a stone or stuccoed house, is in their track as a screen to receive them. The shadow bands seem to vary both in breadth and distance apart at different eclipses, and also in the speed with which they pass along. Though, as already stated, little is known of their origin yet they may be conceived to be due to irregularities in the atmospheric refraction of the slender beam of light coming from the waning or the waxing crescent of the Sun, for be it understood they may be visible after totality as well as before it. It is to be remarked that they have never been photographed.

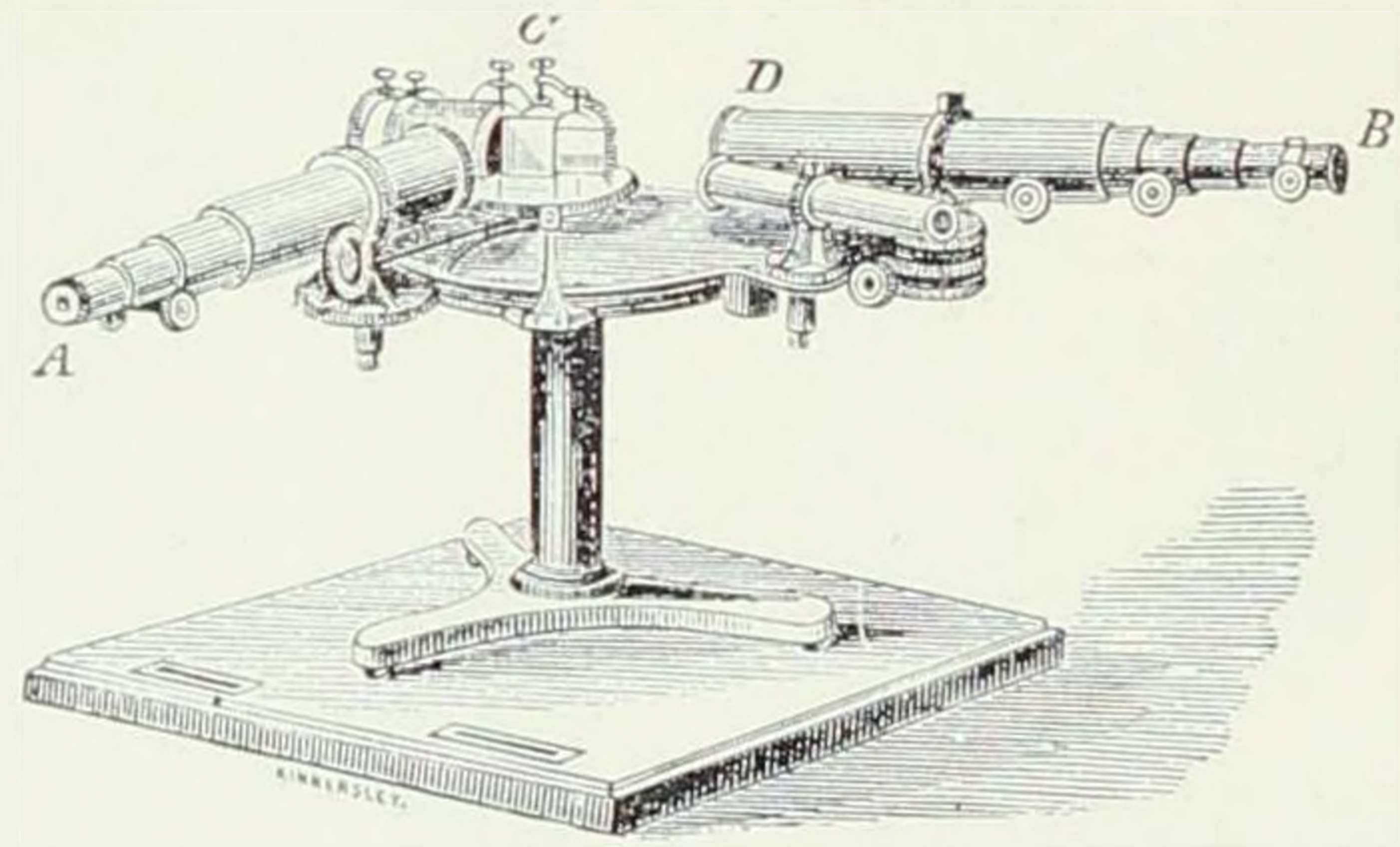
George F. Chambers, *The Story of Eclipses.*



Limbs of the Sun's Crescent

There are instances on record of the limbs of the Sun's crescent appearing to undulate violently on the approach of totality. These undulations were noticed by Airy in 1842 about 6 minutes before totality. Blake, in America in 1869, observed the same phenomenon 8 minutes before totality. In other cases the interval would seem to have been very much shorter—a mere matter of seconds.

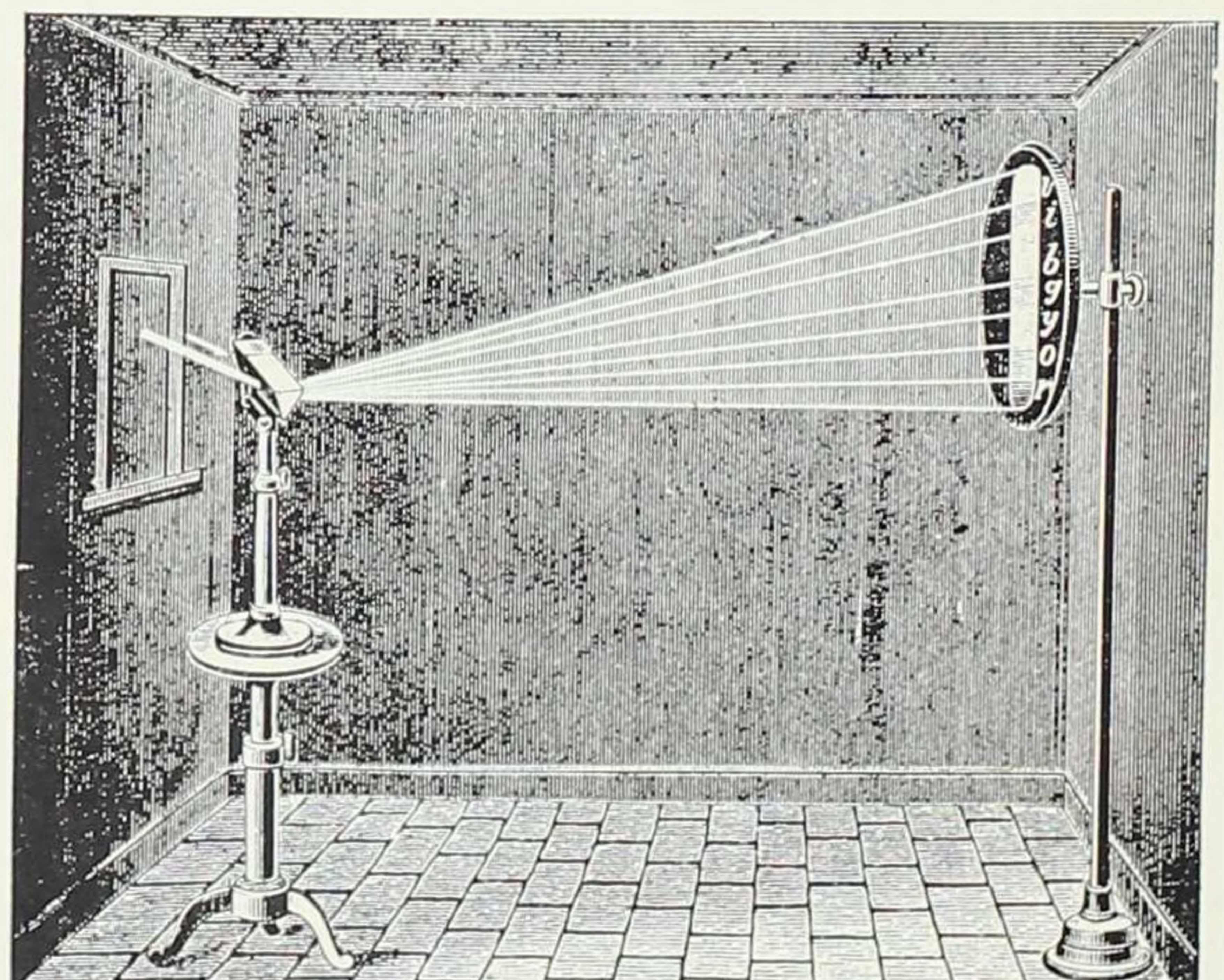
George F. Chambers, *The Story of Eclipses.*



The Spectroscope

This instrument consists of two small telescopes, with a prism mounted between their object-glasses (Fig. 106). The rays of light enter through a narrow slit at A, and are rendered parallel by the object-glass. They then pass through the prisms at C, are separated into the different colors, and, entering the second telescope at D, fall upon the eye at B. A third telescope is sometimes attached, which contains a minutely-accurate scale for measuring the distances of the lines. In addition, a mirror may throw in at one side of the slit a ray of sunlight or starlight, and so we can compare the spectrum of the sunbeam with that of any flame we desire.

Steele, *New Descriptive Astronomy.*



Revelations of the Spectroscope

The Spectrum of the sunbeam is not continuous, but is crossed by a large number of dark lines, called, from their discoverer, Fraunhofer's lines. It is therefore concluded that the sun's light is of the third class just named, and that it is produced by the vivid light of a highly heated body shining through a flame full of volatilized substances.

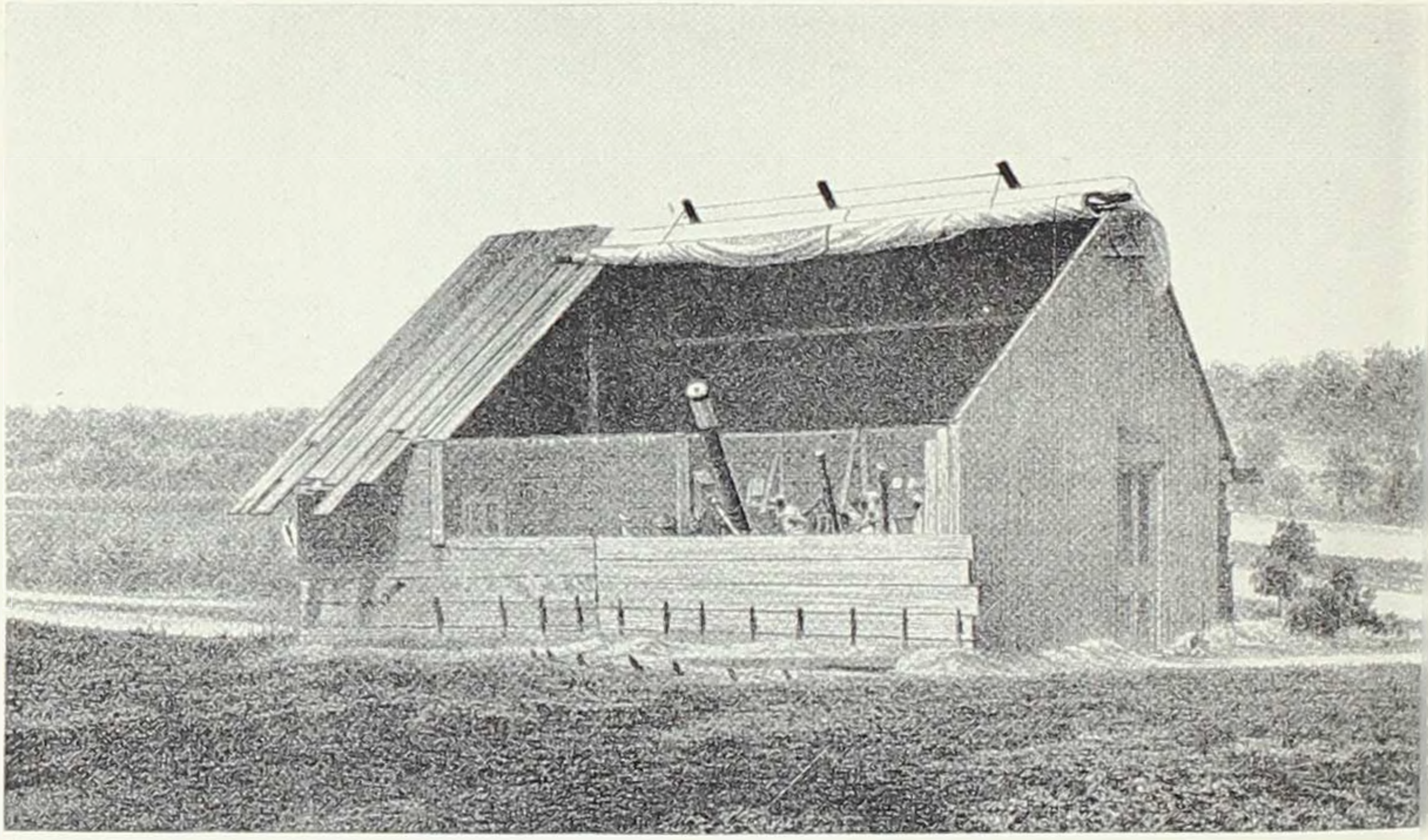
Steele, *New Descriptive Astronomy.*

Ideal Landscape on the Moon

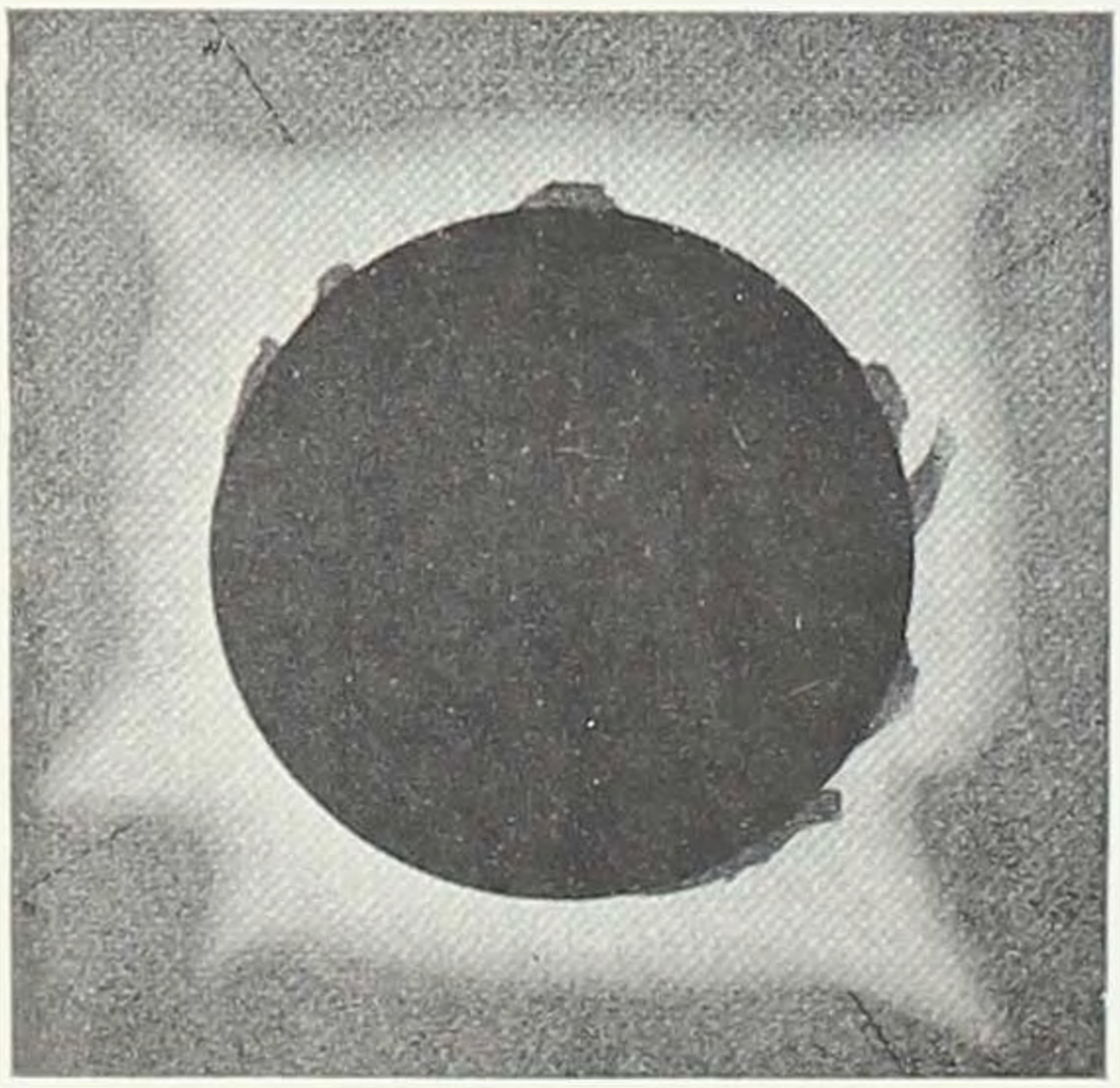
How strange the lunar appearance would be to us! The disk of the sun seems sharp and distinct. The sky is black and overspread with stars even at midday. There is no twilight, for the sun bursts instantly into day, and after a fortnight's glare, as suddenly gives place to night; no air to conduct sound; no clouds; no winds; no rainbow; no blue sky; no gorgeous tinting of the heavens at sunrise and sunset; no delicate shading; no soft blending of colors, but only sharp outlines of sun and shade.*

*The moon is a fossil world, an ancient cinder, a ruined habitation perpetuated only to admonish the earth of her own impending fate, and to teach her occupants that another home must be provided, which frost and decay can never invade. The moon was once the seat of all the varied and intense activities that now characterize the surface of our earth. At one time its physical condition was like that of the parent earth from which it had just been separated: but, being smaller, it cooled faster, and its geologic periods were correspondingly shorter. Its life-age was perhaps reached while the earth was yet glowing.—Read Winchell's Geology of the Stars.

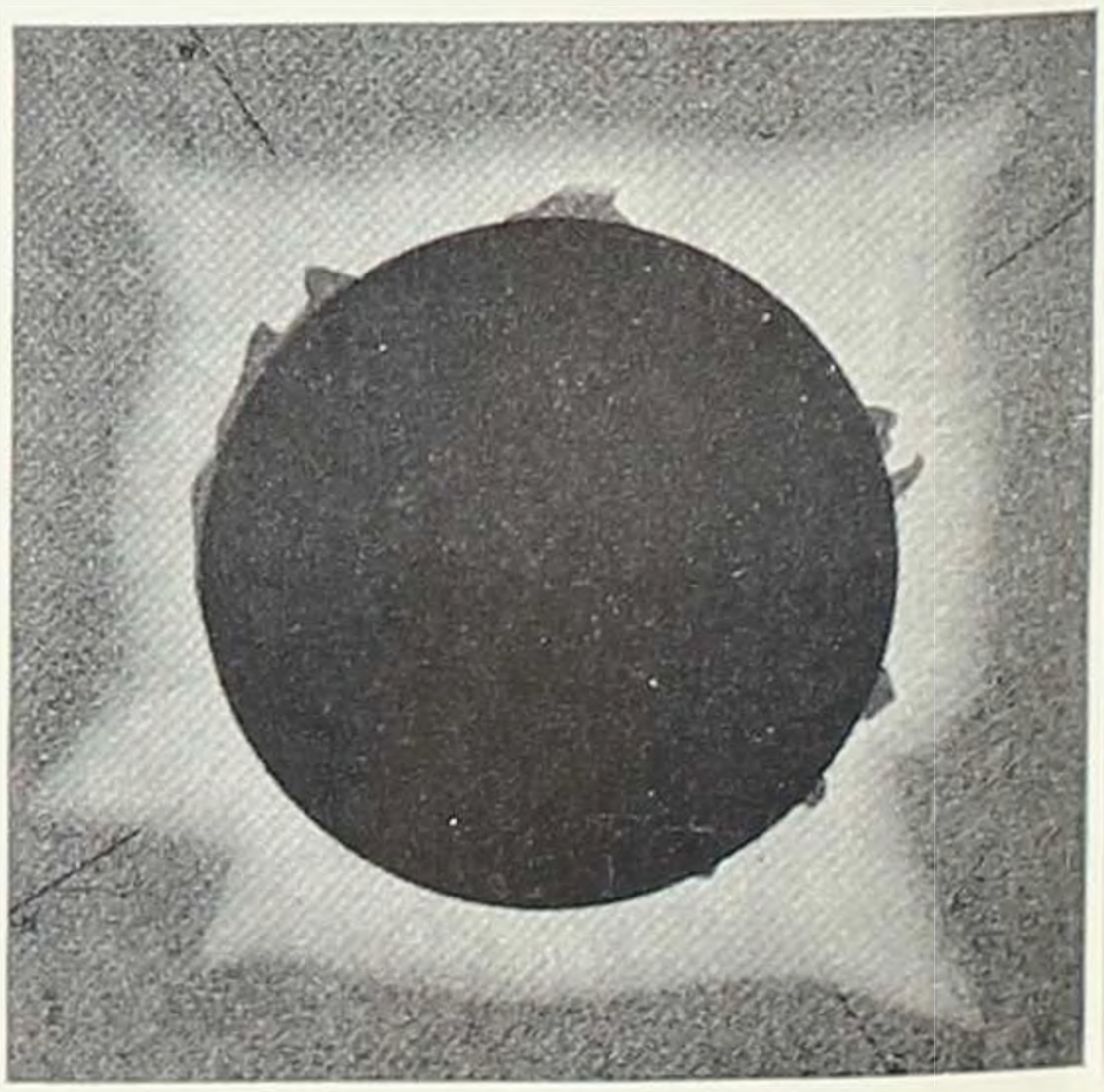
Steele, *New Descriptive Astronomy.*



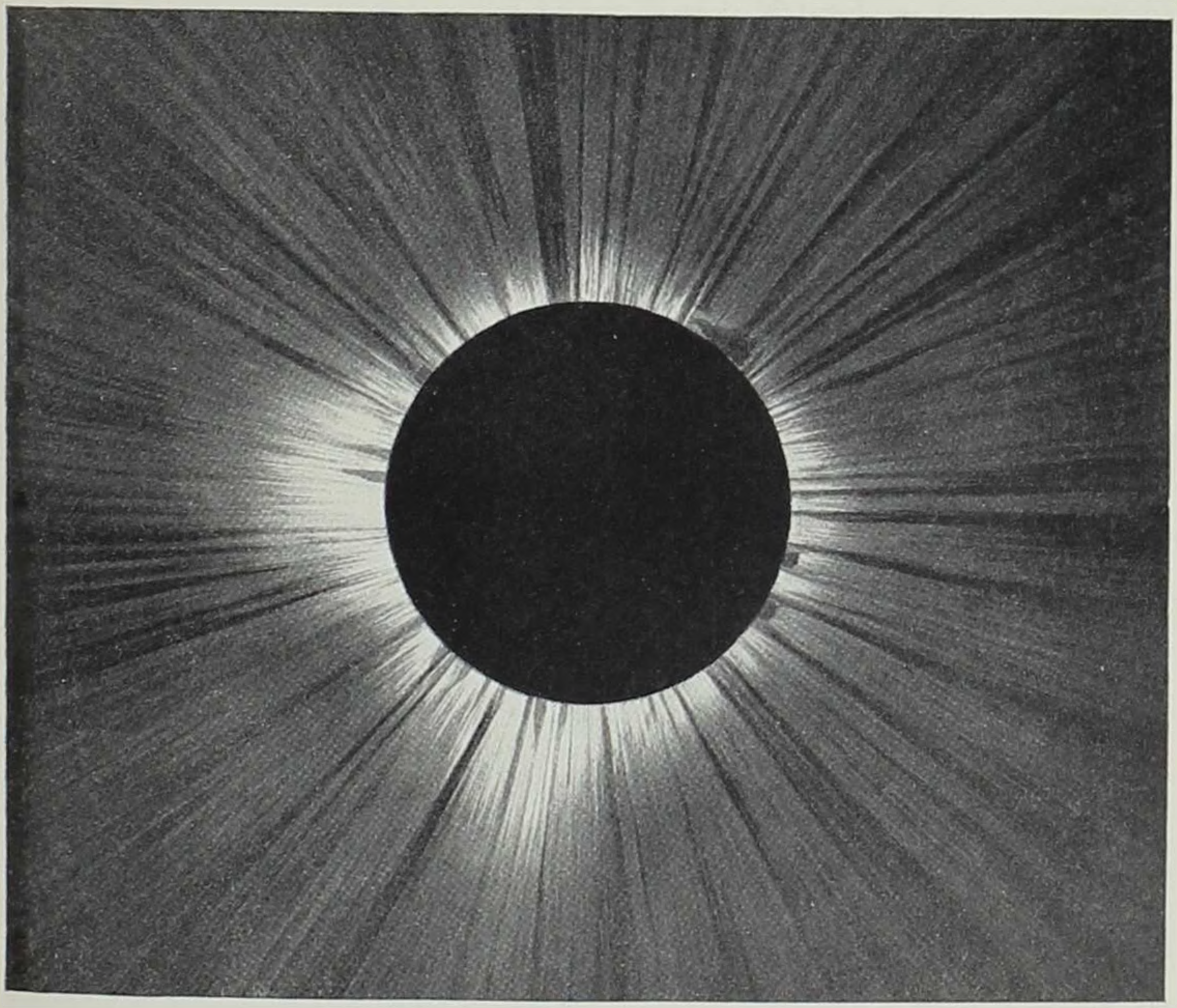
U. S. Eclipse Observatory, with four inch telescope set up at Des Moines, Iowa, for observation of the total eclipse of August 7, 1869.



Appearance of Corona and Protuberances immediately after the beginning of totality.



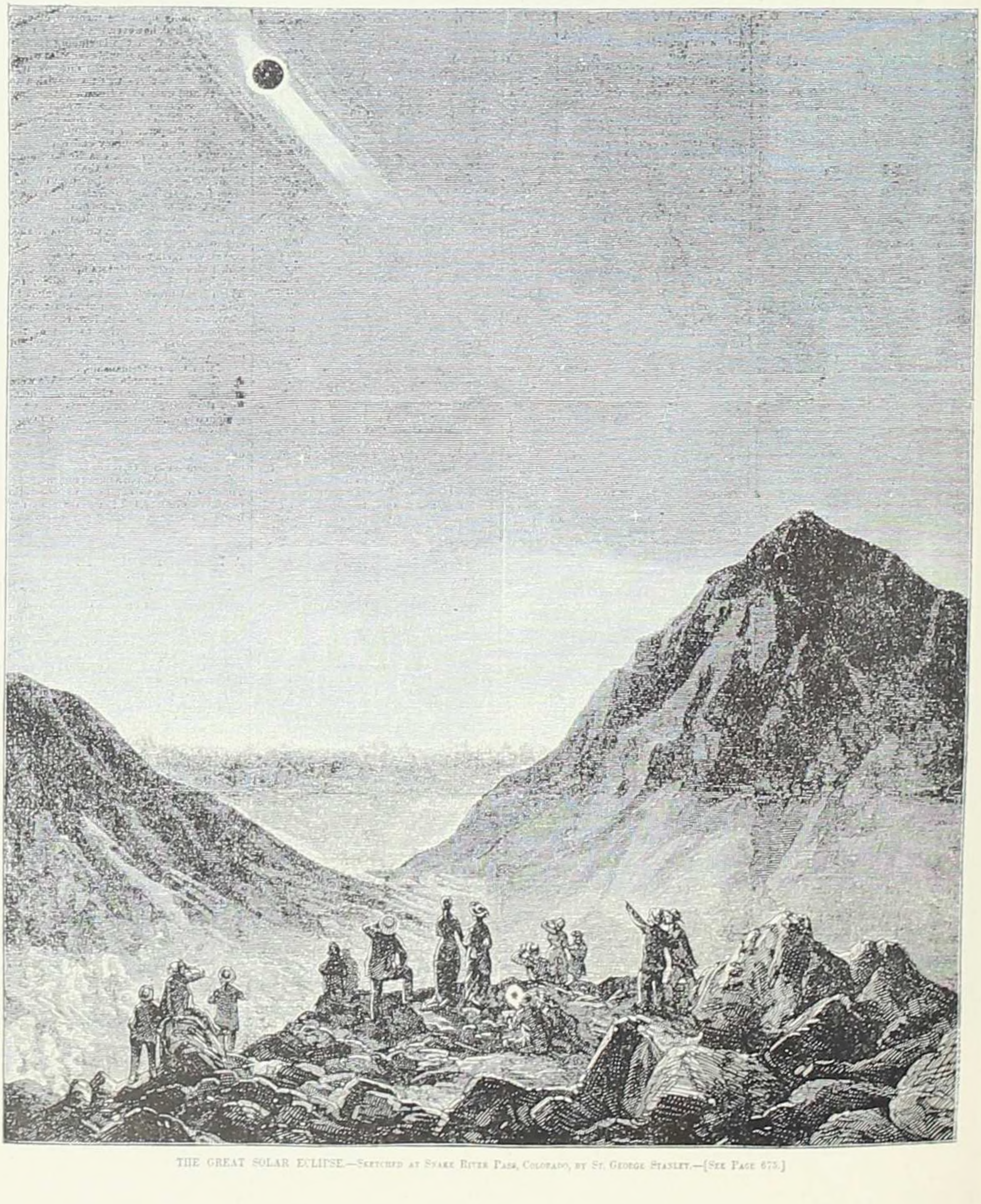
Appearance of Corona and Protuberances just before the end of totality.



The Corona of the Total Eclipse of August 7, 1869, at Des Moines. As seen by the aid of a four inch telescope.

HARPER'S WEEKLY.
A JOURNAL OF CIVILIZATION.

Vol. XXII.—No. 1130.] NEW YORK, SATURDAY, AUGUST 24, 1878. [WITH A SUPPLEMENT. PRICE TEN CENTS.



THE GREAT SOLAR ECLIPSE.—Sketched at Snake River Pass, Colorado, by St. George Stanley.—[See Page 673.]

Newton were giants in the field of astronomy who laid the foundation for our present-day knowledge of the universe.

It is with this brief historical introduction that we turn to the great eclipse of August 7, 1869, the only eclipse that occurred in totality over Iowa since the beginnings of permanent white settlement. Giant strides had been made in the improvement of astronomical equipment, particularly photography, and it was hoped much would be learned from the eclipse in Iowa. Little wonder that scores of leading astronomers were bound for Iowa in 1869 for the big show.

That Iowa was extremely fortunate in the caliber of men who elected to study the eclipse is attested by their national and international standing. Thus, prior to the eclipse a feature story appeared in several Iowa newspapers calling attention to the contributions of Americans in discovering new planets. Only six planets had been recognized and identified up to 1781 when Sir William Herschel "burst through the heavenly enclosures" and discovered the remote planet Uranus. From that time until 1868 the "unwearied industry of astronomers and the powerful aid of the telescope" had added 107 planets to the list. Nearly one-fifth of these telescopic planets, or 23 in number, were discovered by Americans, 8 by Christian Henry Frederick Peters and 9 by James Craig Watson. These discoveries were made between 1854 and 1868, eight of them in the latter year. Peters led the scientific group which came to Des Moines in 1869 while Watson was a key man in the delegation at Mount Pleasant.

Christian Peters was born in Schleswig, Germany, in 1813, and received his Ph.D. degree from the University of Berlin in 1836. Two years later, in 1838, he was a member of the expedition to survey Mount Etna in Sicily. Peters spent ten years in Sicily on scientific work. In 1854 he came to the United States and was identified with the U. S. Coast Survey for four years. He was director of the Hamilton College astronomical survey in Clinton, New York, from 1858 to 1867. In the latter year he was named director of the Litchfield Observatory at Clinton, serving until his death in 1890.

The excellent reports of the eclipse at Des Moines by Dr. Peters led to his selection to lead the U.S. expedition to New Zealand to observe the transit of Venus in 1874. Among his many contributions, he discovered 48 new asteroids and 2 comets. He revised Ptolemy's *Almagest*—the accepted catalogue of the position of the stars. Peters was named to almost all the leading scientific societies and published widely in his field. In Des Moines he used the spectroscope, and confirmed the theory that the protuberances on the sun were in great part composed of hydrogen.

Another outstanding astronomer who came to

Iowa in 1869 was James Craig Watson, a Canadian-born scholar who won signal honors at the Universities of Leipzig, Yale, and Columbia. Watson published 15 astronomical papers before the age of 21 and promptly became professor of astronomy at the University of Michigan. It was while in charge of the Ann Arbor observatory that Watson vied with Peters in the discovery of new planets. He was credited with 22 discoveries. In addition to the Iowa expedition, Watson was on an astronomical expedition to Sicily in 1870, China in 1874, and Wyoming in 1878. He was named director of the Washburn Observatory at the University of Wisconsin in 1879. Before his death in 1880 he had won many national and international awards. During the eclipse of 1869, Watson confined his observations to the Mount Pleasant area.

Astronomer John H. C. Coffin was a professor with the United States Navy before his association with the U.S. Naval Observatory in Washington from 1843 to 1853. From 1853 to 1866 he was a professor of mathematics, astronomy, and navigation at the Naval Academy. He then became chief editor of the *Nautical Almanac* from 1866 to 1877. A student of astronomy for many years, Coffin directed the astronomers assigned to Burlington and designated other strategic locations in Iowa to late arrivals.

When Professor James McClune and President Samuel J. Gummere of Haverford College, Pennsylvania, arrived in Burlington they found that city well-provided with scientists, photographers, and volunteer help. After consulting with Professor J. H. C. Coffin they were assigned to Oskaloosa (an Iowa town that had not been pre-empted by astronomers) as the best place to set up their base. A "natural elevation" north of the main street of Oskaloosa was selected and all were at their telescopes before the beginning of the eclipse.

Professor McClune has left us a good description with a colored picture, reproduced on the front cover of this issue of *The Palimpsest*. According to McClune:

> The most interesting objects which present themselves during a total eclipse of the sun, are the corona or halo which appears around the dark body of the moon when the sun is entirely obscured, ruby-colored or flame-like protuberances of irregular shape, seemingly in immediate contact with the margin of the lunar disc, and luminous streamers or radiations from the brightest parts of the corona. These, and other phenomena observed while the total phase continued, are shown in the annexed drawing [front cover] sketched before the end of the eclipse.
>
> A, brightest part of the corona. At B, the radiation was less luminous than at A, but it extended farther and was interspersed with parallel orange-colored rays. At C, several streaks of orange-colored light were observed. At D, the extension was brighter than in the corona proper, but it was not so bright as at A, B and C. At E, a large rose-colored protuberance appeared, resembling somewhat a balloon or inverted bell pear. Its height was, at least, one-twentieth of the disc, or upwards of forty thousand

miles. At F, a circular ruby-colored protuberance, not so large as the one on the lower limb, was visible the entire period of totality. During some seconds, pink-colored flames spread along the limb on each side of this protuberance, and then faded away. Pink-colored flames were also observed at the part of the limb opposite G, but they soon became invisible. H, point of first contact. I, point of last contact. J, K, L, M, dark body of the moon which appeared, through the telescope, like an immense globe suspended in the heavens.

The luminous streamers or radiations from the corona, arranged themselves nearly opposite, and gave it an appearance not unlike a St. Andrew's Cross. The remaining portions of the corona were by no means uniform in brightness, even for short distances, *lighter* and *darker* portions intermingled.

The breadth of the corona proper, instead of being everywhere the same, as commonly represented, was very unequal. While in some places it reached more than two hundred thousand miles; in other places, and those generally where the rose-colored flames appeared, it did not extend to half that distance.

Professor McClune noted that the "clamor" of the Oskaloosa boys who had gathered to "watch our operations" was "hushed" and a "death-like paleness gradually diffused itself over the countenances of all . . . when the solar rays reappeared" a shout of joy burst from those who had gazed in "mute astonishment; the glow of health overspread the pallid features; . . . and inactivity and dreariness instantly gave place to light, animation and beauty."

Professor McClune was careful to note the reactions of birds and animals to the eclipse:

In consequence of the short duration of the total phase, a little less than three minutes, it could not be expected that the effect on the lower animals would be as manifest as it has been in some eclipses of the sun, in which the total obscuration lasted much longer, nevertheless it was distinctly seen. Bees returned in swarms to the hives, swallows sought their places of nightly abode, fowls ascended the roost, and cattle either huddled together in the fields or hastened to their usual places of shelter.

Upon his return to Philadelphia, Professor McClune made a report to the Controller of the Public Schools on the Solar Eclipse of August 7, 1869, a copy of which is in the possession of the State Historical Society of Iowa.

Of far greater stature was Benjamin A. Gould, a Harvard graduate who was born in Boston in 1824. Gould established and conducted the *Astronomical Journal* (1849-1851) which was reestablished in 1886. Associated with the U. S. Coast Survey from 1852-67, Gould built and directed several observatories. He gauged the difference in longitude between Europe and America by the aid of the submarine cable. He was the first astronomer to use the telegraph in geodetic work, making 15 determinations before the method was introduced in Europe. He did his greatest work in observation of the stars of the Southern Hemisphere. His most important work (for the

Argentine National Observatory) contained zone catalogues giving the position of 73,160 stars and a general catalogue of 32,448 stars in the Southern Hemisphere. He died at Cambridge in 1896.

One should not overlook the name of Charles Augustus Young, to whom must be credited many of the illustrations appearing in this issue. Born in Hanover, New Hampshire, in 1834, Young graduated from Dartmouth in 1853 and gained his Ph.D. from the University of Pennsylvania. He served four months as a captain of the 85th Regiment of Ohio volunteers. He was a professor of astronomy at Western Reserve from 1857 to 1866; at Dartmouth from 1866-77; and then at Princeton until he resigned in 1905. His books on *The Sun* (1882), *a General Astronomy* (1889), *Elements of Astronomy* (1890), and *Lessons in Astronomy* (1891).

The only woman astronomer was Professor Maria Mitchell, who had discovered a new comet in October of 1847. She was the first woman elected to the American Academy of Arts and Sciences. Born on Nantucket Island in 1818, she also was the first professor of Astronomy at Vassar College—1865-1888. Professor Mitchell arrived in Burlington with eight of her lovely students, bedecked with hoop skirts and small parasols. According to the Burlington editor:

The beaux at Des Moines who plumed themselves on their supposed brilliant prospects of captivating these young lady astronomers, must, as soon as possible, pack their carpet bags and make their appearance in Burlington or miss their opportunity. Of course, a lot of sprightly and handsome young ladies, coming "out west" wanted to go to a handsome town, with handsome scenery adjoining, and handsome young men by the score, and of course came to Burlington. Des Moines may have an old observer or two, but the wide awake and handsome ones of both sexes are all in this city, we judge.

While much was said of the reaction of birds and animals to the complete eclipse, the fright of a person, unaware of the sudden advent of a total eclipse, could be so terrifying as to prove fatal. On August 24, 1869, the *Lansing Mirror* carried the following:

DEATH FROM FRIGHT AT THE ECLIPSE.—A Mrs. Gifford, residing in the north part of Marion county, in this State died from fright from seeing the eclipse. She was not aware of its coming, and being alone with her little child, was so terrified at the sight that she fled with her child to a neighbor's where she lingered in an unconscious state until death relieved her on Saturday.

Death from fright seems almost impossible, considering the widespread publicity that had preceded the eclipse of 1869. Apparently Mrs. Gifford had neither read, nor been told, about the eclipse by others. Thus, the *Iowa City Republican* on July 28 carried the following widely disseminated report by Professor Charles A. White, who was with the astronomers located at Des Moines.

The sun will rise eclipsed in the interior of Siberia, on the morning of August 7, 1869, whence the shadow will move in a northeasterly direction, then turning eastwardly and southeastwardly, will pass over Behring's strait and northern Alaska about noon local time. Thence, moving across part of British North America, it will enter the United States in Montana; between two and three P.M., local time. Moving thence across western Nebraska, it will pass diagonally through Iowa—passing over Sioux City, Des Moines and Keokuk about 5 o'clock. Thence it will pass still to the southeast, over Jacksonville, Illinois, across southern Indiana, central Kentucky, eastern Tenn., into and across North Carolina, and will touch the sea-coast at Pamlico sound; and will finally leave the earth not far from the Bermudas. It will be visible in all parts of the United States, and total over one hundred miles wide along the line just indicated, the sun being hid more than four minutes.

The many comments by Iowans, and by the eminent scientists who came to Iowa, form a valuable record for students of this astronomical phenomenon. Writing briefly in his *Eclipses of the Sun* almost a century later, Samuel Alfred Mitchell declared:

The eclipse of August 7, 1869, crossed America diagonally from Alaska to North Carolina, and fortunately clear skies greeted the observing parties. Little of the important work accomplished will be noted in detail here. Spectroscopically, the most valuable discovery was that the spectrum of the corona was continuous but was traversed by a single green ray. This green line was detected independently by both Harkness and Young, the latter identifying its position as coinciding with the line numbered 1474 on Kirchhoff's scale. But since this line 1474 is due to iron, it was surprising and perplexing in the highest degree to find it present in the corona and reaching such great heights above the sun's surface. In spite of the apparent coincidence, it was evident that the substance causing the green line was not iron. To it the name *coronium* was given.

The discovery of the above mentioned spectrum led to concentrated research by astronomers in the decade following 1869. And Charles A. Young was a leading astronomer in studying the mystery of the corona which could now be attacked by four methods: the telescope, photography, the polariscope, and the spectroscope. But while new discoveries were made, and new theories were advanced, new problems arose following each successive probe. Thus, the Eclipse of 1878 was considered to have only one-tenth the brightness of the Eclipse of 1871, but it threw out coronal streamers to the incredible length of ten million miles! Why? Truly, the generation of 1869 had many memories to carry with them, memories that, though awesome, brought joy and understanding to their children and grandchildren.

William J. Petersen

The Eclipse of March 7, 1970

Maria Mitchell, the first recognized woman astronomer, would have been delighted had she been permitted to live to watch the Eclipse of March 7, 1970, pass over her birthplace on Nantucket Island. She also would have been thrilled to know that more Americans witnessed the Eclipse of 1970 than there were people in the United States in 1869. This was possible because the Eclipse of 1970 was a typical 85-mile wide shadow that passed along the East coast of the United States over the Florida Gulf Coast, Okefenokee Swamp, Georgia, the Carolinas, Norfolk and Virginia Beach, Nantucket, Nova Scotia, and Newfoundland.

The contrast that 100 years have made in mankind's knowledge of the sun and moon has been tremendous. In 1869 a score of well-known astronomers, with their photographers and scientific associates, hastened to strategic points in Iowa to take notes and make a permanent record of the total eclipse on August 7. In 1970 hundreds of astronomers hastened to Mexico to catch what they hoped would be the greatest and most significant details ever secured from a total eclipse of the sun.

One of the last total eclipses of the sun that was viewed in the United States was back in 1878, and astronomers had to go to Colorado and Wyoming in the Rocky Mountains for the best view. Their next opportunity to view a total eclipse in the United States was a long way in the future—54 years— and few if any astronomers of 1970 would be around to see it. This would occur in 2024 when a total eclipse would follow a narrow band covering the United States from Texas to Maine. It will be a long time after 2024 before Iowans would witness a total eclipse over their own backyards.

WILLIAM J. PETERSEN

A JAMES VAN ALLEN SPECIAL

After completing the above, the writer accompanied Dr. James Van Allen, noted astronomer at the University of Iowa, to the Physics Library, where they consulted Theodore Ritter von Oppolzer's "Canon Der Finsternisse" (1887) the authoritative catalogue of eclipses from 1207 B.C., to 2161 A.D. From this source, we found the following total eclipses touching some part of the United States would occur up to 2024 A.D.

7-10-1972—Alaska and the Northern Canadian Provinces
2-26-1979—Washington, Idaho, Canada, Hudson's Bay
8-21-2017—Directly across the Central United States
4- 8-2024—Mexico, Texas, Southeastern United States

A Voyage to the Moon--1862

By M. Schele deVere, of the University of Virginia

What a curious almanac the people in the moon must have! There, days are as long as years, and day and year are equal to our months: Twenty-nine days and forty-five minutes. The seasons differ but very little from each other. On the equator there reigns eternal summer, for the sun is ever in the zenith; the poles are buried in eternal winter. The days are of equal length throughout the year; all days equally light, all nights equally dark. The absence of an atmosphere deprives the moon of the sweet charms of a twilight, and glaring day would follow gloomy night with the rapidity of lightning, if the slow rising and setting of the sun did not slightly break the suddenness of the transition.

Human eyes, however could not bear the fierce contrasts of the light and shadow; they would long in vain for the soft intervals between the two extremes, the other colors, which beautify our world with their joyous variety and soft harmony. The sky is there not blue, but even in day time black, and by the side of the dazzling sun, the stars claim their place and shed their light in the heavens. Near the poles the mountain tops shine in unbroken splendor year after year, but the valleys know neither day nor night, for they are ever but scantily lighted by the faint glimmer reflected from the walls that surround them.

That side of the moon which is turned away from us, has a night of nearly fifteen days; the stars only, and planets, shine on its ever dark sky. The side we see, on the contrary, knows no night; the earth lights it up with never ceasing earth-shine, a light fourteen times stronger than that which we receive from the moon. We recognize our own light, lent to our friend, in the faint, grayish glimmer of that portion of the moon which before and after the new moon receives no light from the sun, but only from the earth, and it reflects it back again upon us. Mornings in fall show it more brilliant than evenings in spring, because in autumn the continents of the earth with their stronger light illuminate the moon, while in spring she only receives a fainter light from our oceans.

Our orb appears to the man in the moon as changeable as his home to us, and he may quite as correctly speak of the first or last quarter of the earth, of new earth and full earth. The whole heaven moves before him once in twenty-nine days around its axis; the sun and stars rise and set regularly once in the long day; but the vast orb of our earth is nearly immovable. All around is in slow, unceasing motion; the mild face of the earth alone, a gorgeous moon of immense magnitude, never sets nor rises, but remains ever fixed in his zenith. It there appears sixteen times larger than the moon to us, and daily exhibits its vast panorama of oceans, continents and islands. Bright lights and dark shadows are seen in ever varied change, as land or water, clearings or forests appear, new with every cloud, and different at different seasons.

The man in the moon has thus not only his watch and his almanac daily before him in the ever-changing face of the earth, but he may, for all we know, have maps of our globe which many a geographer would envy on account of their fullness and accuracy. Long before Columbus discovered America, and Cook New Holland, our lunar neighbor knew most correctly the form and the outlines of the new continents. There was no New World for him, and there is none left. He could tell us the secrets of the interior of Africa, and reveal to us the fearful mysteries of the polar seas.

But how he on his side must marvel at our vast fields of snow, our volcanoes and tropical storms and tempests—he who knows neither fire, nor snow, nor clouds! What strange fables he may have invented to explain the shadows of our clouds as they chase each other over sea and land, and hide from him in an instant the sunlit landscape!

And stranger still, on the side of the moon which is turned from the earth, he knows nothing at all about us, unless news reach him from the happier side. Or he may undertake—the great event in his life—a long and painful journey to the bright half of his globe, to stare at the wondrously brilliant earth-star, with its unread mysteries and marvellous changes of flitting lights and shadows. Who knows what earnest prayers may rise from the moon also, full of thanks for the floods of light and heat we pour upon them, or of ardent wishes that their souls might hereafter be allowed to dwell in the bright home of the beauteous earth-star?

Only in one point has the dark side of the moon a rare advantage. With its dark, unbroken night, a true and literal "fortnight," it is the observatory of the moon, and the best in the whole planetary system. There no light from the earth, no twilight, hinders the most delicate observations, and neither clouds nor fogs ever step between the telescope and the heavenly bodies.

It is a cold world, however, all over that pale, lifeless globe. The rays of the sun can hardly warm that thin, imperceptible atmosphere, and on the plains near the equator, a fortnight of burning sun and scorching heat, which parches and withers all life, is instantaneously followed by another fortnight of fearful cold. Human eyes could not bear this ever cloudless, colorless horizon. Over the mournful scene that looks like one vast ruin of nature, broods eternal silence. The thin air cannot carry the waves of sound. Not a word, not a song is ever heard amid those desolate mountains; no voice ever passes over the sunken plains. Pain and joy are equally silent. A rock may glide from its ancient resting place, a mountain may fall from its eternal foundation—no thunder is heard, no echo awakened. Grim silence reigns supreme. No rainbow is set in the clouds as a token from on high; storm and tempest give not way to the merry song of birds and the gentle, balmy winds. There we look in vain for green forests with their cool shade, for playful fountains to cheer and to refresh us. Far as eye can reach we see nothing but bare mountains, desolate masses of rock, countless stones amidst huge boulders of glassy fabric. Human bodies could not endure these long days and endless nights; human souls could not bear that silent, lifeless world of desolation.

Even this universal devastation, however, does not absolutely preclude the existence of created beings on the moon. We can think as little of a noble tree without leaves, flowers and fruits, as of an orb, rolling in silent, serene majesty through the midnight firmament, without organic life and intelligence. The earth teaches us the same lesson by simple logic. The earth also, once incandescent and scarcely cooled, has been the theatre of fearful convulsions; gigantic forces have torn her interior, and deeply furrowed her surface. But hardly was apparent peace restored upon the still unshapen globe, when it produced, at the word of the Almighty, a creation full of fresh life, at first rude, raw and imperfect, like nature itself, but daily growing nobler, more varied, more spiritual. We know this, for each varied organization of such life, as it perished, has left its epitaph written upon imperishable monuments.

May we then not believe, that, like the earth, the moon also has had her first period of storm and strife? Of this, her vast plains, her rugged craters and mysterious furrows, give proof in abundance. The present seems to be her period of rest, during which nature gains strength to produce a life-endowed creation. This we conclude from her unchanging face, and her clear, imperceptible atmosphere. If this be so, then there must come a time for the moon as for the earth, though perhaps after thousands of years, when thinking, intelligent beings will rise from her dust. The whole universe has some elements in common. The great cosmic powers, light and heat, are the same first conditions of organic life throughout the vast creation; they send their waves through the wide ocean of the world, and play against the shores of all of its gigantic islands. There is, no doubt, vital power in them, and at the proper time, at His bidding, life will spring forth and order will reign, where now destruction and chaos seem to rule supreme.

The moon is one of the great heavenly bodies, all of which work together in beautiful harmony to the glory of God. They all move, like loving sisters, hand in hand through the great universe. As they live with each other, so they evidently live for each other. Superstition, ignorance, and even wilful exaggeration have much obscured the effects of this mutual influence. The moon especially has been treated as if she existed for the benefit of the earth only. From the times of antiquity the world has been filled with fanciful stories of her influence on our weather, our vegetation, our health, and even the state of our mind. Many have believed in a daily direct communication between the two great bodies; they looked upon meteoric stones as coming to us directly from the craters of the moon's volcanoes, and the fertile imagination of happy dreamers reduced a crude mass of half-true, half-fabulous details into a regular system, long before the moon itself was even but tolerably well known to us.

It is notorious that men of such rank as Piazza and Sir William Herschel considered certain light appearances in the moon as volcanic eruptions, whilst a German astronomer of great merit, Schroeter, saw in them enormous fires raging in some of the capitals of our satellite! Meteoric stones are, in our day, fortunately better explained. Unless volcanoes on the moon had a force thirty times greater than our own, they could not project masses far enough to come within reach of our atmosphere. Such gigantic and continued eruptions could, moreover, not fail to cause some permanent change in the surface of the moon, of which no trace has as yet been perceived.

Great heavenly bodies commune not, like men, by throwing bombshells at each other; their influence is felt through the agency of light, heat and attraction. The light of the moon, it is true, is ninety thousand times weaker than sunlight, and that its rays warm not, is a popular assertion. But people are not always right, with due deference be it said, even in matters of science. They used to say that moonlight nights were colder than others. So they are; but the moon is not to be blamed for it. She shines brighter when the sky is not obscured; but when that is the case, the earth also grows colder, because radiation is increased. Thus the two facts are perfectly true, only there is no connection of cause and effect between them. Melloni's experiments, made in 1846, prove even that the rays of the moon have a certain amount of heat, though so little, that the most powerful lenses fail to make it perceptible on the thermometer.

A Change of the Moon

A plain, clever man is my neighbor Gray,
And we often take counsel together,
He lives in a farm-house over the way,
And is wise in respect to the weather;
He watches all signs, night, morning and noon,
But pins his great faith on a change of the moon.

In dull, drizzly May, when the signs were all bad,
And day after day it kept raining,
When the farmers were sad and the women were mad,
And all the wide world were complaining;
Farmer Gray went on piping the very same tune,
"It will never clear off till a change of the moon."

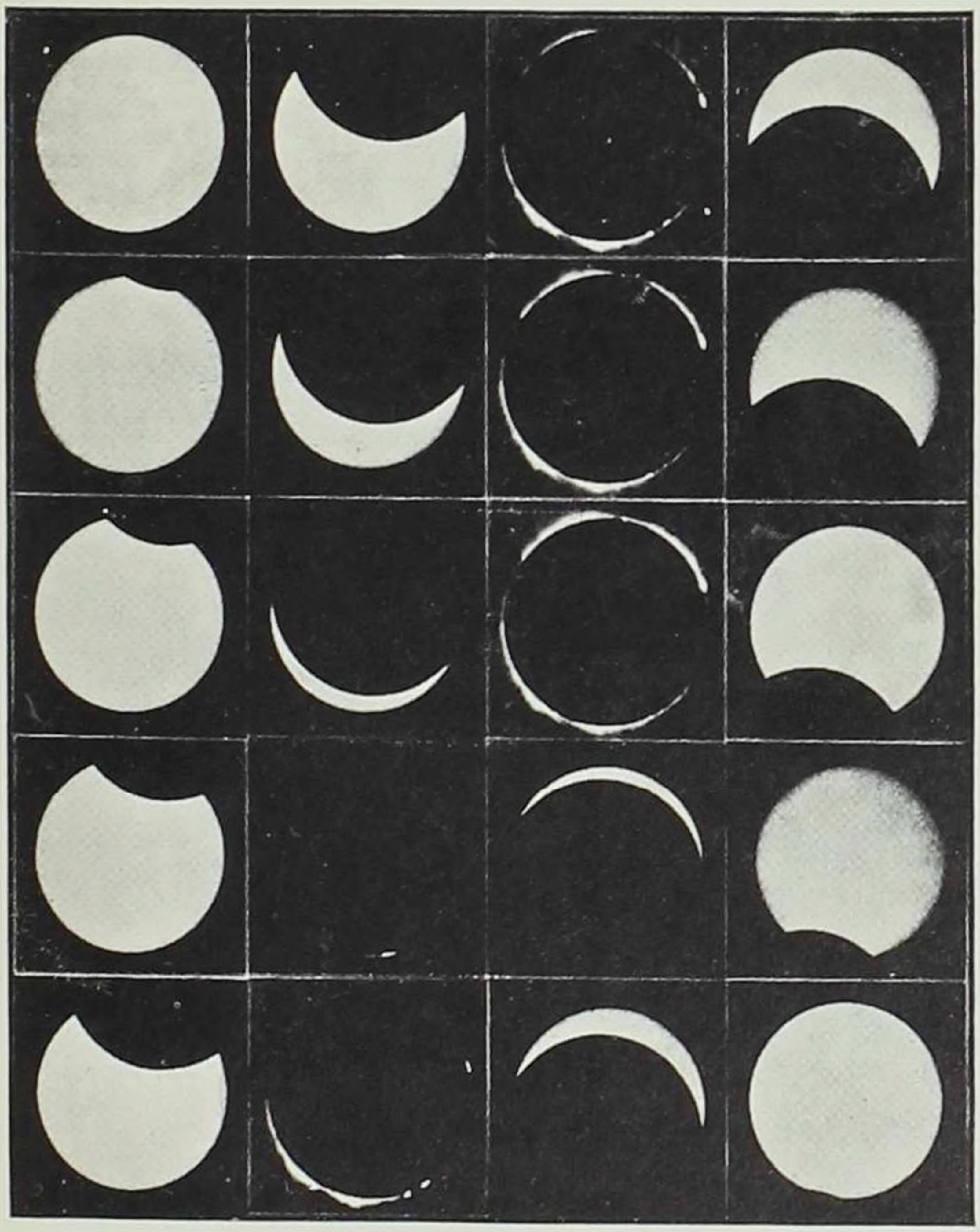
I admired his great faith, for the east wind blew strong,
From icebergs and isles of the ocean,
The moon had changed thrice, while the storm kept along,
But my neighbor still stuck to his notion;
At length it cleared up, near the coming of June,
Two days and a half from a change of the moon!

In the long summer drought, when the springs had run dry,
Not a sign of a rain-cloud appearing,
Neighbor Gray, who knew the wherefore and why,
Spake out, and his accents were cheering;
"We are bound to have different weather soon,
For to-morrow, you know, there's a change of the moon."

I sit by his fire, on a sharp winter night,
When the glass below zero is ranging,
My neighbor instructs with honest delight,
(For his faith in the moon is unchanging),
That a thaw will set in by Saturday noon,
For just at that time comes a change of the moon.

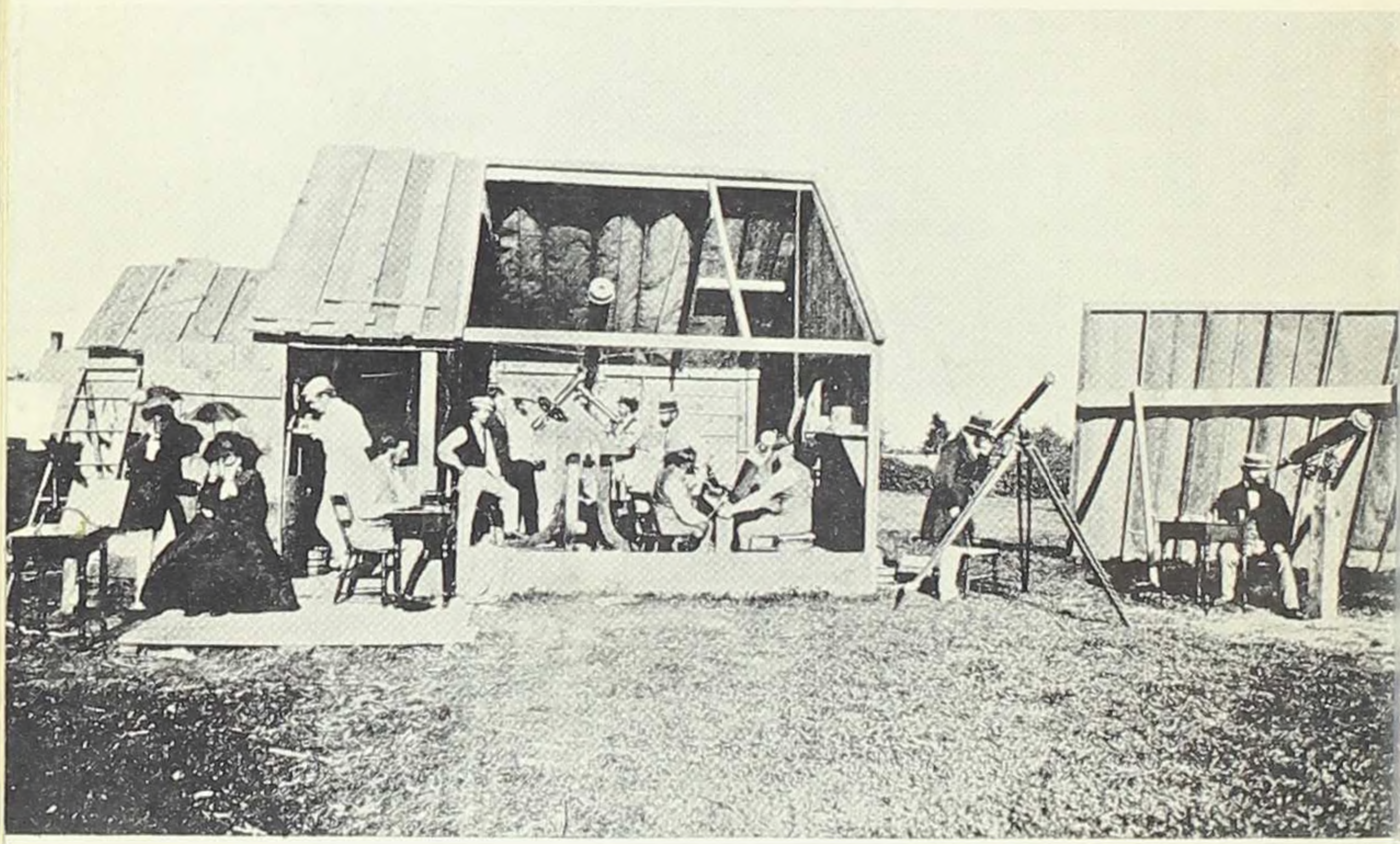
Heat and cold, wet and dry, or whatever the grief,
Under which our poor earth may be lying,
Neighbor Gray knows the source whence must come our relief;
No use of this groaning and sighing;
He tells all he meets that the change will come soon,
"We must wait, my dear friends, till a change of the moon."

He cares not a jot for the college or school,
And passes their doings unheeded,
Still he holds by the old philosophical rule,
To name no more causes than needed,
And as one is enough, the rest let us prune,
And make all things proceed from a change of the moon.



The Eclipse of 1869

This photograph was taken at Burlington. The transit begins in the upper left-hand corner and progresses from top to bottom in columns from left to right.



The Burlington Observator

Photo taken on Sunday after the Eclipse of 1869 with astronomers in their respective positions. Professors John H. C. Coffin, Charles A. Young, Alfred M. Mayer, and Benjamin A. Gould; Professor Maria Mitchell of Vassar and Miss Helen S. Starke; and Messrs. O. H. Willard, H. C. Phillips, J. Mahoney—photographers; and Miles Rock, O. H. Kendall, and M. C. V. Emerson.