the cusps are correctly indicated. The streams of light already mentioned are also shown, but I did not succeed, with the crayons which I had at hand, in giving precisely the correct delineation. The form of these streams and their relation to the cusps are indeed clearly indicated, but there was a general effect which, having failed to indicate sufficiently in the drawing, I will attempt to describe.

The appearance in the telescope reminded me of the great comet of 1858, which I observed attentively. There was in the corona first a uniform band of light, pearl-white, as in the case of the bright comets, then streams of luminous matter flowing out, and afterward spreading and uniting, thus forming a shell-like envelope to the sun. It seemed as if the cusps were merely rents in this envelope, and as if I were looking into a partially transparent shell, within which was a brilliant core emitting luminous streams. The manner in which the exterior halo enveloped the solar corona is not exactly shown in my drawing. The cusps were dark at the apex, and quite bright at the extremity of the corona, but not nearly so bright as the other portions of the corona, so that, being of a brilliancy not much in excess of that of the outer halo, the appearance was that of the formation by the latter of a sort of envelope passing down into the indentations of the former. The color of the moon should be of a deep neutral tint, and the prominences should be of a light rosy tint. They were not so red as in 1869, but exhibited a more glowing intensity of light.

In conclusion, permit me to say, that, being fully convinced from these observations that the bright corona whose limit was well defined is really an appendage of the sun, composed of glowing gas, I concluded to observe carefully whether it might not be visible during the partial eclipse, and I was able to see it distinctly, by the visibility of the limb of the moon beyond the limb of the sun. At $20^h\ 38^m$ chronometer time, or only ten minutes before the last contact, I could distinctly trace the limb of the moon to a distance of two minutes of arc from the sun's limb. Hence I venture the prediction that a careful scrutiny will show the corona during any partial eclipse, and I conceive it to be very possible indeed that the Janssen-Lockyer method may be extended so that the corona may be studied at all times, as well as the prominences. If I am not mistaken as to the indications of what I saw and what I have here recorded, the attempt ought to be made.

Thanking you very sincerely for your kind invitation to take part in the expedition, I submit through you to the world this statement of the results of my observations, with the hope that they may be regarded as having some value in perfecting our knowledge of the physical constitution of the sun.

I have the honor to be, sir, yours, very truly,

JAMES C. WATSON.

Professor BENJAMIN PEIRCE,
Superintendent of the United States Coast Survey.

REPORT OF OBSERVATIONS OF THE TOTAL SOLAR ECLIPSE OF DECEMBER 22, 1870, MADE AT JEREZ DE LA FRONTERA, BY JOSEPH WINLOCK.

SIR: In the autumn of 1870, I undertook at your request the organization and direction of a party to be employed in observing the total solar eclipse of December 22, in the same year.

The place which I selected for the observations was Jerez de la Frontera, in the south of Spain, near Cadiz. The advantages of this station known to me at the time were that it lay near the central line of the eclipse, and was connected by railroad with Cadiz. The climate of the whole of Southern Spain was known to be on the whole favorable to observations, but I could gather no definite information as to the climate of Jerez itself as compared with other Spanish stations. I was gratified to learn, on my arrival there, however, that the chance of clear weather in the southwest of Spain is at least equal, and probably superior, to that at stations farther east. In confirmation of this view, I subjoin a statement compiled from a meteorological record kept between August 15, 1864, and September 30, 1870, at the house of Mr. Richard Davies, in Jerez. A thermometer at a distance from any building would no doubt show a larger range of temperature than is apparent from this record. The thermometer was observed at 8 a. m., 12 m., 3 p. m., 8 p. m.

Highest temperature, in degrees of Fahrenheit, recorded during—

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1864								87	88	73	67	62
1865	66	64	61	70	80	85	88	86	87	80	70	61
1866	63	64	69	74	76	84	90	94	86	82	77	74
1867	69	71	72	79	85	87	92	88	87	80	73	67
1868	65	63	70	74	83	88	85	89	89	76	66	65
1869	63	65	64	70	72	76	93	88	85	83	65	61
1870	61	58	68	74	80	87	92	89	85			

Lowest temperature, in degrees of Fahrenheit, recorded during—

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1864								74	66	60	56	48
1865	50	49	52	56	60	68	70	71	71	63	58	46
1866	48	50	52	56	61	63	62	70	66	62	57	55
1867	52	54	54	59	62	68	70	70	67	62	56	46
1868	48	51	53	56	62	69	72	71	65	63	57	55
1869	53	56	56	57	66	67	73	75	70	60	52	48
1870	47	51	57	57	62	72	73	72	73			

Number of days which seem to have been generally cloudy.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1864								3	2	6	1	5
1865	9	6	5	8	9	0	1	3	4	5	10	3
1866	7	9	8	6	4	3	0	0	1	1	8	3
1867	15	3	11	3	4	1	1	2	1	5	5	8
1868	7	10	5	2	4	4	1	2	5	1	11	14
1869	6	4	6	4	5	2	0	1	2	2	6	10
1870	9	1	5	3	1	1	0	1	2			
Mean	8.8	5.5	6.7	4.3	4.5	1.8	0.5	1.7	2.4	3.3	6.8	7.2

Number of days on which rain is recorded to have fallen.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1864								1	2	16	2	10
1865	14	8	5	11	6	1	1	3	5	5	15	4
1866	6	7	12	10	10	5	0	0	2	6	2	4
1867	14	3	12	2	7	2	0	1	3	3	7	5
1868	7	6	3	6	2	2	0	2	7	1	12	8
1869	6	4	9	1	8	3	0	3	2	3	7	10
1870	8	7	6	4	3	3	1	1	4			
Mean	9.2	5.8	7.2	5.7	6.0	2.7	0.3	1.6	3.6	5.7	7.5	6.8

Number of nights in which rain is recorded to have fallen.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1864								1	2	3	7	4
1865	3	3	6	2	1	1	1	0	0	2	2	3
1866	2	4	4	0	0	2	0	0	1	4	2	2
1867	4	0	3	1	1	3	0	0	0	1	0	1
1868	3	0	1	3	0	0	0	2	5	1	0	3
1869	2	0	0	0	2	0	1	2	4	2	1	4
1870	4	1	4	4	1	0	0	3	2			
Mean	3.0	1.3	3.0	1.7	0.8	1.0	0.3	1.1	2.0	2.2	2.0	2.8

The party under my direction consisted of the following gentlemen: Mr. G. W. Dean, assistant United States Coast Survey; Professor C. A. Young, of Dartmouth College; Captain O. H. Ernst, United States Army; Professor S. P. Langley, Western University, Allegheny, Pennsylvania; Professor E. C. Pickering, Massachusetts Institute of Technology; Mr. Alvan G. Clark, of Cambridgeport, Massachusetts; Mr. Henry Gannett, assistant at Harvard College Observatory; Mr. O. H. Willard, of Philadelphia, photographer to the expedition, and his assistant, Mr. Mahony; Mr. Ross, assistant to Professor Pickering; Mr. J. White, of Cambridge, Massachusetts, carpenter to the expedition. Three gentlemen whom I met in Spain, as will hereafter be stated, Mr. Gordon, Mr. Norman, and Mr. Pye, also assisted me in the observations of the eclipse.

The instruments furnished for the expedition by Harvard College Observatory were as follows:

1. Equatorial telescope from west dome, aperture 5¼ inches.
2. Equatorial, ordinarily used as the finder for the large telescope of the observatory; object-glass by Merz, aperture 4 inches.
3. Equatorial, aperture 3 inches, mounted on brass stand of Bowditch comet-seeker.
4. Comet-seeker, with reflecting prism, and eye-piece at end of axis; aperture 4 inches.
5. Small telescope, bought of G. M. Searle, with equatorial mounting; aperture 3 inches.
6. Lerebour's telescope, on stand; aperture 3 inches.
7. Quincy comet-seeker; aperture 2½ inches.
8. Telescope of 6 inches aperture, mounted equatorially, with clock-work from west dome, for taking photographs; lens corrected for the chemical rays.
9. Stationary telescope for instantaneous photographs, with plane mirror to throw the sunlight upon the lens; aperture 4 inches, focal length 32½ feet.
10. Spectroscope by Troughton & Simms, with two prisms of flint-glass.
11. Spectroscope by Alvan Clark & Sons, with one flint-glass prism.
12. A telescope of 8 inches aperture, with equatorial mounting and clock-work, borrowed from Messrs. Alvan Clark & Sons, for use in photography.

Also various smaller instruments and apparatus belonging to Harvard College Observatory, among which may be mentioned a transit theodolite by L. Casella, No. 3129; a chronometer with galvanic recording attachment, by C. Frodsham, No. 3451; cameras for the photographic telescopes.

The United States Coast Survey furnished transit instrument No. 5 and chronograph No. 2; also a chronometer with galvanic recording attachment. Dartmouth College sent an equatorial telescope, four spectroscopes, a comet-seeker, and other instruments, which will be found described in the report of Professor Young. Professor Langley brought a small portable telescope, a Savart's polariscope, and a polarizing solar eye-piece. Professor Pickering also brought apparatus for observing polarization. Captain Ernst brought a sextant and several small telescopes; and Mr. Willard was provided with photographic materials.

I left New York by the Cunard steamer of November 3, and proceeded, by the steamer leaving Southampton November 19, to Gibraltar, where I arrived November 26; and thence, three days later, went to Cadiz. The instruments, which were left at Liverpool in charge of Mr. A. G. Clark and Mr. White, arrived soon after, and were, without much delay, passed through the custom-house, the officials at Cadiz, to whom I take this opportunity of expressing my thanks, being disposed to accommodate the expedition as much as possible. I have also to acknowledge my obligations to General Duffie, our consul at Cadiz, for his courtesy and assistance.

Through the kindness of our vice-consul at Cadiz, Mr. Younger, I was made acquainted with Mr. Richard H. Davies and his brother, wine-merchants, of Jerez. The kind attentions of these gentlemen made the selection of a place for the observations and the mounting of the instruments a comparatively easy task. Mr. Davies at once placed at our service his own country-seat, "Olivar de Buena Vista," which I directly perceived to be admirably suited to the wants of the expedition, from its buildings, its convenient distance from the city, and its proximity to the telegraph line which I expected to use in determining the difference of longitude between our station and the observatory of San Fernando. I also obtained from Señor Riviero, through the intervention of Mr. Gordon, leave to occupy his estate, called "Recreo," which is situated about three-eighths of

a mile north-northwest from the station at "Olivar." The roof at this place furnished a fine position for the small instruments and for observations of polarization and of general phenomena, while the heavier instruments which required to be placed upon the ground, and needed no extended view of the heavens, found ample accommodations at "Olivar."

I considered the expediency of dividing the party and sending some of them to Marbella, or Estepona, or into the mountains in the neighborhood of Jerez; but I became satisfied that no advantage could be expected from this. Those best informed upon the subject assured me that the only wind that could bring harm to us would be equally disastrous to stations on the Mediterranean; and my own observations at Gibraltar and elsewhere, of the manner in which clouds collected about the Spanish mountains, convinced me that it would be better to avoid the high land. I therefore concluded to keep the party together at Jerez, and the result seems to have justified this decision.

I reached Jerez on December 5, and by December 9 all my party were upon the ground. In spite of the difficulty of procuring lumber, referred to in the report of Mr. Dean, all the preparations for the observation of the eclipse were completed in due season, and each observer's work had been assigned to him. As the reports of other members of the party contain full details of the work undertaken by them, I have but little to add before giving an account of the photographic work and of my own observations.

A telescope and spectroscope, Nos. 2 and 11 in the list of instruments, had been intended for the use of Mr. C. S. Peirce, in Sicily, but by an accidental misunderstanding were brought to Jerez with the other instruments. Under these circumstances, I at first intended to assign this telescope and spectroscope to Professor Langley, but as he preferred to observe with the polariscope, the spectroscope was detached and assigned to Mr. Pye, who used it with a small hand-telescope, placed in front of the slit, and corroborated Professor Young's very important observation of the "spectrum filled for an instant with bright lines."

Mr. Pye, Mr. J. C. Gordon, and Mr. Norman, who have been mentioned above, were English gentlemen of scientific tastes, who kindly offered me their assistance in Spain, and formed a valuable addition to our corps of observers, Mr. Gordon and Mr. Norman being most accomplished draughtsmen. Mr. Gordon used his own telescope of about 3 inches aperture, mounted on a tripod stand, and made the sketch, plate 4; his report will be found below. Mr. Norman, unluckily, had an instrument which rendered his skill in sketching of little avail.

The stationary telescope, No. 9 in the list of instruments above, was used by Mr. Gannett in photographing the full disk of the sun, and the partial phases of the eclipse; two of these photographs are represented in plate 1. It was part of my plan to take simultaneous pictures of partial phases with the three photographic telescopes, and by means of micrometric measurements of the negatives to test the relative and absolute accuracy of the work done by each telescope. But the unfavorable weather of the day of the eclipse prevented the satisfactory execution of this project.

Telescopes Nos. 8 and 12 in the above list were used in photographing the total phase—the first by Mr. Willard, and the second by Mr. Mahony. As in 1869, the photographs were taken in the principal foci of the object-glasses of both instruments. Guided by my experience in observing the eclipse of 1869, at Shelbyville, I had arranged the cameras for these telescopes in such a way that at the instant of totality the slides which were used for making instantaneous exposures of the plates for partial phases might be drawn out and thrown aside, so that there might be no danger of cutting off any part of the corona. This apparatus, although rough in appearance, answered its purpose admirably in 1869. But on this occasion I was induced to allow another to be substituted for it, shortly before the eclipse. The new contrivance seemed very ingenious and unobjectionable, and not having sufficient time to consider it attentively, I supposed that it would answer as well as the old one. Unfortunately the slide of this apparatus could not be removed, and the opening in it was small, so that, in the best of the two photographs taken, part of the outer corona was lost, although the whole of the inner corona seems to have been secured. Its outline is distinctly seen, surrounded by the fainter light which alone was limited by the diaphragm.

The triggers which released the slide in the apparatus which was used required a light for their successful management, and the accidental blowing out of this light caused some confusion in the photographic work, which may have resulted in additional defects in the pictures obtained.

The picture of the corona, plate 12, taken at Shelbyville in 1869, represented, in my opinion, all the bright part of the corona, and its true form. From the rapidity with which the intensity of the light diminishes toward the borders, what lies outside of this must be very faint. The extent of the visible corona has been variously estimated by different observers, in all eclipses of the sun. It seems to depend in no unimportant degree on the clearness of the atmosphere. This is especially noticeable in the accounts of the eclipse of 1851, given in Vol. XXI of the Memoirs of the Royal Astronomical Society. In these accounts the estimate of the breadth of the corona is less when the sky is represented as clear; so that in some instances it is estimated but little larger than it appears in photographs.

My plan was to take three photographs of the corona with the 6-inch and one only with the 8-inch telescope; that is, to leave the plate exposed in the latter during nearly the whole of the total phase, hoping that this large aperture and long exposure would secure the outer faint light, while the bright parts of the corona would be distinctly represented in the photographs made with the smaller instrument. Everything was in readiness for carrying out this plan, but the discouraging aspect of the weather on the day of the eclipse, which is sufficiently described in the reports of my colleagues, made it hopeless to attempt so much. Accordingly, instead of giving directions for a certain number of exposures of specific duration, I simply directed the photographers to watch their opportunity, and to use their own judgment as to the time of exposure, guided by the intensity of the light, modified, as it most likely would be, by the clouds. One good picture was, if possible, to be obtained with each telescope. The photographs actually taken during totality are represented by the engravings, plates 13 and 2, the first being taken by Mr. Willard and the second by Mr. Mahony. Several positives on glass were taken by Mr. Willard immediately after the eclipse, some of which were left in England, and have probably served as the originals of the prints that have appeared in several publications on this subject. These positives were taken from the first photograph, plate 13; the second was regarded by Mr. Willard as a failure, and I did not know of its existence until after my return home. I do not know how to account for its appearance. Mr. Willard attributes it to the shaking of the telescope by the wind. Inasmuch as the outer edge of the light fell clearly inside of the mark of the diaphragm in the plate, I thought it worth while to have an engraving made from this photograph, if only to show how far from the image of the moon the plate had been affected by light from the corona, the aperture having been 8 inches and the time of exposure, as nearly as I can ascertain, one minute and a half.

It is not easy to represent correctly in engravings the appearance of the original negatives. It has been found impossible to print the outer faint lights directly from the negative, in which, however, they can plainly be seen. The method adopted in the case of plate 2, from the photograph made with the 8-inch telescope, has been to make a drawing from the projection of the negative upon a screen by means of a powerful calcium light. The drawing is intended correctly to exhibit the extent and form of the different masses of light which it depicts, but not their relative brightness. None of the photographs of the total phase taken under my direction, either in 1869 or in 1870, can be fully represented by photographic printing. In plate 13 there is seen an inner corona, resembling in form and dimensions the corona of plate 12, from the Shelbyville photograph. In the positives on glass no trace of this is seen when the picture is held between the eye and the light, but it becomes very distinct when the picture is placed on a dark surface and examined by reflected light. The same thing is apparent in a less degree in the photograph of 1869. In this case the prominences, which are very distinct in the negative and correctly represented in the engraving, are not shown at all in photographic prints. The same is true of the internal structure of the corona. In the original negative this has a fibrous or woolly appearance, which is lost in copying by photography, and is not shown in plate 12, which is a copy on steel of a photograph, with the prominences added by a tint-stone.

The position angles on the margin of these engravings are counted from the north pole of the sun through the east. They were obtained in the following manner: The camera remained undisturbed from the beginning to the end of the eclipse; the edges of the glass plates were straight and parallel. Hence, by placing the plate containing the total phase between two plates showing partial phases before and after totality, I was enabled to determine the position from the line of cusps with all the accuracy attainable in a diagram of the proportions of these plates.

In the spring of 1870 I received from Father A. Secchi an engraved copy of a photograph of the eclipse of 1860, taken by him in Spain; and one of the first points in it which attracted my attention was the remarkable resemblance between the form of the corona therein depicted and that shown in the photograph taken in 1869. The photograph of 1870 was subsequently found to resemble each of the others. This resemblance extends to the principal depressions in the corona as well as to its general arrangement about the sun's axis. I communicated these facts at the time to the American Academy of Arts and Sciences, and illustrated them by the drawing, plate 3, in which the three pictures are reduced to the same scale and placed in the same position, with the north pole uppermost.

Besides the general work incident to the organization and equipment of the expedition, and the care of securing the conditions which offered the best chance of success in all the observations undertaken, I had laid out for myself the special occupation of endeavoring to ascertain the nature of that fainter portion of the corona which lies outside the limits of the best photographs, and concerning which there have been such conflicting accounts and opinions. I had no doubt that the brighter parts of the corona would receive from other observers more than their due share of attention; and I felt confident that sooner or later the principal facts relating to their constitution would be settled without the aid of total eclipses.

I undertook simply to get answers to these two questions: What bright lines are visible in the spectrum of this fainter light, and whether or not any dark lines are to be seen in it. My previous experience in Kentucky had made me aware of the serious loss of time, as well as of the confusion and liability to error, inseparable from any method of fixing the positions of lines in the spectrum during totality by means of a scale to be read and recorded at the time of observation. It seemed to me very important that there should be some means of making a permanent record of the place of a line at the instant when it was seen, without loss of time or distraction of attention. This record could then be measured and studied at leisure. These considerations led me to an invention which I thought well adapted to its purpose, and likely to be useful in spectroscopes of any construction. It consists in rigidly attaching a point or cutting tool to that part of the spectroscope which is moved to effect a pointing on a given line of the spectrum, in such a way that it may be pressed upon a plate suitable to receive the record when the telescope is directed to the spectrum line to be recorded. Any number of lines from a given spectrum may thus be registered, and by sliding the plate on which the record is made in a direction normal to that of the motion given, by changing the pointing of the spectroscope to the recording tool any number of spectra may be registered side by side for ready comparison. The first and the simplest method that would occur to any one would be to use a point to prick a hole in some soft substance. But being afraid that the dots so produced might be confounded with small spots or accidental indentations on the plate, and that this would lead to confusion and uncertainty in identifying the record, I thought it safer to give the point a sliding motion after it touched the plate, so as to make a mark similar to those on the limbs of graduated instruments, about which there could be no mistake. The manner in which this was done is illustrated in plate 19 and plate 11, Fig. 3. The instrument shown in plate 19 was completed and exhibited to the American Academy in October, 1870.

In Professor Young's spectroscope, I attached the recording tool to the prisms. In all these instruments, I dispensed with clamps and used double-threaded tangent screws to give rapid motion in pointing without danger of slipping when the record should be made. I also applied to the spectroscopes small reflectors by which the observer could see the image of the sun on the slit without removing his eye from the telescope.

My method of using this mechanical recording apparatus was first to register some standard lines of the solar spectrum or of the spectrum of some well-known substance; then to slide the plate and to register the lines to be determined by the side of the first series. The plate is then to be put under a microscope and the places of the lines determined with a micrometer. For general use in spectroscopes I proposed to rule a scale of standard lines of the solar spectrum, and to interpolate from this any desired scale, one of wave lengths, for instance, or that of Kirchhoff. This scale should then be permanently attached to the spectroscope in such a way that the place of an observed line in the adopted scale may be read off at a glance.

The telescope which I used at Jerez was an equatorial of 5¼ inches aperture, and about 7 feet focal length, made by Alvan Clark; it was mounted without clock-work, and had attached to it, as a finder, a very excellent telescope of 2½ inches aperture, and a power of about 40, known as the Quincy comet-seeker. These instruments are Nos. 1 and 7 of the list given above, and the spectroscope used was No. 10 of the same list.

The cross-wires of the finder were carefully adjusted the evening before the eclipse, so that when the finder was pointed on a star its spectrum would appear in the spectroscope. I adjusted the width of the slit by faint clouds or patches of blue sky, so that if dark lines were present they could not escape me, and a faint continuous spectrum might not be cut off. Mr. Alvan G. Clark, whose skill in everything pertaining to a telescope insured careful and judicious management of the instrument, was stationed at the finder to direct the telescope to the parts of the corona which were to be examined, and at the same time to observe incidentally general phenomena. Mr. Clark took his place at the finder just before the beginning of the total phase. On the instant of totality, he directed the telescope, according to my instructions, upon the faint part of the corona, about 12′ from the edge of the moon, and seized every opportunity offered by openings among the clouds previous to the re-appearance of the sun to obtain for me a view of the coronal light unmixed with reflected rays. He several times reported, "Now it is clear here;" and on looking into the spectroscope I saw a continuous spectrum, not very faint, with four bright lines. The appearance remained unaltered, except in brightness, as Mr. Clark moved the instrument from point to point of the corona. I carefully registered these lines on the silver plate, and then requested Mr. Clark to move the instrument away from the sun until the lines should disappear. As he did so, I tried to note the order of disappearance of the lines. They all disappeared nearly at the same time, having previously faded out together, one of them, which proves to be that known as 1474, seeming to be somewhat more persistent than the rest. When the lines had all vanished, Mr. Clark reported that the instrument was then pointed about 25′ from the sun.

The double-threaded screw which moved the telescope of my spectroscope enabled me to sweep rapidly from one end of the spectrum to the other. During my examination of the corona I looked carefully for dark lines, and saw none. I examined critically the whole region above F, and saw nothing but a continuous spectrum. I looked for lines here because I had seen broad lines near H in 1869.

Some standard solar lines had been registered on the silver plate before the total phase, and the plate had been moved as has been described to receive the lines of the corona. After the total phase, the principal lines of the solar spectrum, as high as F, were again registered.

The cross-wires in the spectroscope had been made very coarse for fear that it would be difficult to see them. No such difficulty was found, and with finer wires the precision of the pointings upon the lines might probably have been somewhat increased. But no considerable error can have occurred, since the dark lines registered before the total phase agree well with those registered after it, and the same lines ruled on mica at the present time can be superposed on those recorded upon the plate, which have in fact thus been identified.

An examination of the silver plate shows that the coronal lines observed were C, a line near D, 1474, and F. C and F agree exactly with the dark lines. The line near D is less refrangible than the sodium line D, by a difference greater than I supposed the error of observation could be. Line 1474 is ruled a little more refrangible than Kirchhoff's line, perhaps not more than can be attributed to an error of observation under the circumstances.

The last adjustments of my own instrument were completed at 11 o'clock on the morning of the 21st, and at that time the sky was perfectly clear, and there was every reason to hope for fair weather on the day of the eclipse. Our preparations were complete; nothing that could be thought of had been neglected; all of the party were experienced observers; each was familiar with his instrument, and with one or two exceptions had been out to observe the eclipse of 1869. At 4 a. m. on December 22, I found the heavens nearly covered with clouds, and every appearance of an approaching storm. From that time to the very instant of totality the prospect was disheartening; and while we have to regret that much of the value of our work was lost or impaired by the clouds, it is even now a matter of surprise to me, when I recall all the circumstances, that so much was done and that so many things were seen.

JOSEPH WINLOCK.