6. Possibly it is worth while to continue the search for intra-Mercurial planets.

7. Observe differences of color between the different parts of the moon's disk, or bright spots upon it.

F.—*Naked-eye observations.*

1. Note any changes that occur in the appearance of the corona during the totality, and differences of color in its different parts.

2. See if the outer boundary of the corona is like the boundary of a *cloud*.

3. Look for the dark bands reported to move over the surface of the earth at the moment of totality by Secchi and others.

4. Note what portion of the sky is darkest during the totality—it should be a *ring*.

G.—*Physical observations.*

1. Measure the radiant heat from the corona with a thermopile and galvanometer without a telescope and ascertain the effect of interposing different transparent screens of known thickness, (*e. g.*, a screen of glass, a screen of quartz, a screen of alum, &c.,) in order to ascertain the *quality* of the heat.

2. With a linear thermopile (like that used in Rosse's experiments upon the moon) explore the image of the corona formed in the focus of a telescope in order to ascertain the relative temperatures of its different portions.

3. Having suspended a small magnet by a wire in such a manner that it shall be maintained at an angle of about 30° with the magnetic meridian, observe (by means of a mirror attached to the magnet, and a telescope with a scale) whether the magnet *twitches* at all as the moon in its progress covers or uncovers spots and prominences, and especially whether it experiences any unusual disturbance at the beginning or end of totality. (I do not expect any.)

ALLEGHENY OBSERVATORY,
Allegheny, Pennsylvania, April 15, 1871.

SIR: I have the honor to submit the following report of the observations made by me, with the party under your charge, at Jerez, Spain, on the solar eclipse of December 22, 1870.

Together with Captain Ernst, Professors Young and Pickering, Mr. Ross, and some members of the Sicilian party I left Southampton, England, on the 26th of November, in the Peninsular and Oriental Company's steamer Poonah, and reached Gibraltar on the evening of December 1. Here we staid some days awaiting a boat for Cadiz, and as it seemed uncertain when the regular steamer would leave, Captain Ernst and I started in advance of the rest of the party in a small Spanish vessel, reaching Cadiz on the 8th and Jerez on the 9th of December.

I had limited the instruments taken with me, by your advice, to a small portable telescope, a Savart's polariscope, and to a polarizing solar eye-piece, and to these was added at Jerez an equatorial telescope of 4 inches aperture, without clock-work or circles, the property of the Harvard College observatory. This instrument had been fitted with a small spectroscope, which was removed some days before the eclipse. The instruments actually employed by me were the following:

1. The equatorial just mentioned. It has a good objective, which I have frequently used on close double stars with high powers, the images being sharp and free from diffuse light. Tried by all usual tests it is a more than ordinarily good glass, and if no positive results were obtained by the direct study of the coronal structure with it, it was due to no defect of the instrument. The mounting is by Troughton & Simms, but the tube was for the occasion bolted to an equatorial stand of iron, made by Messrs. A. Clarke & Co. for another telescope. This iron stand rested on a pier which I had made of the only accessible material: two pieces of joist sunk to the depth of three feet below the soil, surrounded by well-rammed earth, and united at the bottom and at the

top by a capping of 2-inch plank. The iron stand was intended for use in a more northern latitude, and to bring it to approximate adjustment, the top of the wooden pier was cut at such an inclination that the bed-plate, when bolted down, was inclined at a sufficient angle to its normal position to bring the polar axis to the needed inclination. The other adjustments of the instrument were made with as much accuracy as the absence of its circles permitted, and as its chief office was to enable the observer to follow the sun during the brief time of the eclipse, this was more than sufficient. Still attached to the tube was the finder, a small telescope of about 1½ inches aperture.

The iron bed-plate and the hollow cone for receiving the polar axis, which were cast in one piece, were bolted to the pier, but the tube with the polar axis attached was not too heavy to be lifted by two persons, and transported at night or during rain to the shelter of the adjacent building.

2. To the finder of the large telescope was applied the Savart's polariscope, with which it was intended to study the corona, with special reference to the plane of polarization; a matter as to which previous observers were not agreed. As the Savart is an instrument which, though well adapted to detect minute proportions of polarized light, presents its results in a form easily misconstrued, it will be well to describe the one employed, and the precautions taken to insure its proper use. This is the more necessary as many of the observations made by its aid in previous eclipses are so given in published accounts as to leave their real meaning in doubt, and on this occasion the results appeared to be conclusive as to a point hitherto open to question.

3. The principal telescope above described was intended for the study of the intimate structure of the corona, near to the sun, but as the power which it seemed best to employ was much too high to enable the observer to view the whole disk at once, a second telescope was used to save the loss of time in exchanging eye-pieces. This was a smaller instrument, moving in altitude and azimuth, on a tripod stand. It was of about 3 inches aperture, and 3½ feet focal length, and was used with a terrestrial eye-piece of a power of 30 diameters, which embraced the whole of the sun, and of the actually seen corona, in one field of view. A heavy wire in the eye-piece could be rotated, and set at any estimated position angle.

I had been deeply interested by the appearance of the outer coronal rays, extending to perhaps a solar diameter from the moon, which I saw in the eclipse of 1869, with insufficient optical aid. More lately it seemed, from the unpublished testimony of at least one trustworthy observer, that the coronal structure near the sun was even more remarkable. More, in fact, than one had already seen or believed himself to have seen it, filled with curves approximately hyperbolic, with their vertices turned toward the sun; and drawings made by observers at earlier eclipses, when rescrutinized, were found to lend countenance to the idea that such a structure had before been seen, though it might have been imperfectly noted.

The interesting inferences to be drawn from such a fact would be evidently premature, till so singular and unanticipated an observation had received general confirmation. At the same time, the study of the structure of the external rays, so remarkably striated, (as they appeared the year before,) promised to throw light on the question of their solar or terrestrial origin.

I felt, therefore, that the use of the spectroscope and polariscope would not supersede the necessity of direct telescopic scrutiny; and hoping, with a good instrument and attention chiefly directed to this point, to obtain evidence on disputed questions of interest, I gladly found this class of observation, together with the use of the polariscope, assigned to me.

Knowing that Professor Pickering was to devote himself exclusively to polariscope phenomena, I arranged my own work so that our observations might as far as possible be supplementary to each other, and, having decided to give only a limited part of the two minutes of totality to this, judged that it would be best to attempt only what there was time to do deliberately, and to confine myself to a determination of the existence or non-existence of radial polarization.

Owing to the weather, the direct observations, as it will be seen, though not without interest, were indecisive of the points previously mentioned, and the results obtained with the polariscope assumed relatively more importance. I return, therefore, to a description of the preparations made for the use of the latter instrument.

The Savart's polariscope, which I used, is of the usual size, having a Nicol's prism of about 3-inch aperture, and crossed plates of quartz, which had been adjusted imperfectly by the maker.

To use the instrument to the best advantage, the quartz plates were together rotated, relatively to the Nicol, till the bands attained their greatest intensity, and in this position they were then permanently fixed, so that thereafter prism and quartz plates had but one motion of rotation together. In this position the central band is in the principal section of the prism, and the quartz and Nicol being relatively fixed, and the instrument receiving light polarized in one plane, the colors attain their maximum intensity, when the bands are parallel to the plane of polarization; (in this case the central band is dark;) and again they are at right angles to it, (in this case the central band is white.) Of the colored bands in the particular instrument employed, ten or twelve are distinctly seen, each being over one degree in width, so that when the little instrument is directed to the moon, its disk is more than covered by one of them, and the corona cannot well cover two of the bands at once.

It is desirable, however, that several of the bands should be seen projected on the source of light, and accordingly the polariscope was adjusted to the finder of the telescope already referred to, and the magnifying power (linear) being about twelve times, the image of the moon was now found to cover four of the bands with their intervening spaces. No sensible polarization was caused by the glasses of the finder. Let the telescope be now directed to the reflection of the sun in water at apparent noon, and let the polariscope be rotated till the bands attain their maximum intensity, at which time, if parallel to the plane of polarization, they are vertical and with the black band central, presenting the appearance indicated in the accompanying sketch (Fig. 1, Plate No. 28,) except as to color.

The circle gives the relative size of the moon's disk. For distinction, this may be called the normal position of the instrument, whose relation to the telescope is also given, when that is stated to be east or west of its pier. The upper part of the milled edge at the eye-end is now marked by filing a notch deep enough to be distinguished in the dark, and the adjustment is completed under conditions which can be reproduced at any time, and are not likely to be mistaken.

If the Savart, still directed to the water, be rotated, the bands rotate with it, growing fainter till it has been turned through 45°, when they vanish; appearing again as the rotation continues, and growing stronger up to 90°, when they are horizontal and again at a maximum of intensity, but with the light band central. At 135° they have again disappeared, and at 180° have resumed their original appearance. The same changes, in the same order, are repeated through each half revolution.

If we suppose the instrument to be left undisturbed in its normal position, but the plane of polarization of the incident light to be rotated, the same phenomena will present themselves as before.

The bands remaining vertical, they will disappear when this plane has been rotated through 45°, re-appear in full intensity with the light band central at 90°, and so on.

If we now suppose a point of light behind the center of the image of the moon in Fig. 1, and that the light is polarized in radial planes passing through this point and the eye of the observer, it is not difficult to anticipate and render an account of the appearance to be presented. It is conventionally shown in Fig. 2, Plate No. 28. The directions of four out of the infinite number of planes of polarization are represented by dotted lines.

The central band is in the vertical plane passing through A B. It will present a uniform intensity thoughout. The extremities of the next band, C D, are crossed by the radial planes at a slight inclination near C D and at a greater and greater, as the diagonal H I is approached. Near C the intensity of the band will be slightly diminished, and it will grow progressively fainter, till it crosses the ray polarized in the plane of H I, where the band (since it here makes an angle of 45° with the plane of polarization) will disappear altogether, regaining its intensity as it approaches the horizontal line, and repeating the same changes in an inverse order to D. Similar effects will be presented, with easily recognized modifications in the other bands, so that the general appearance will be as in Fig. 2, Plate No. 28.

We have now considered the effect which may be anticipated in viewing light, radially polarized, and it is the appearance which the corona would be expected from the theory of our instrument to present, if its light were polarized only in planes passing through the *center* of the sun.

Since the sun, however, emits light from every point on its surface, and is a sphere of dimensions very considerable in relation to the size of the corona, the appearance to be presented at an eclipse can hardly, on any theory, be expected to be that of strictly radial polarization. On subsequent reflection, while preparing this report, it has seemed to me that the modifications due to this relatively great size are more important than would at first appear, and may explain the fact that the bands at the time of the actual eclipse were not traced up to the limb. At any rate, the word "radial," which is frequently used as if the sun's dimension could be neglected in discussing the phenomena of polarization in the corona, must not mislead us as to the fact that it is incorrect, if used in any other than the general sense in which, for want of a better, I employ it.

It seemed proper, before the eclipse, to rehearse the observations then to be made; under circumstances so varied as to give similar conditions to any which it could be anticipated might present themselves.

Professor Pickering and I prepared a very simple apparatus, which enabled us to do this. Behind an opaque disk, subtending an angle of half a degree, was placed a lamp whose light was reflected to the eye by a suitable device, so as to be polarized in any single plane desired, or else radially in all planes passing through the hidden flame and the eye, at the pleasure of the experimenter. From trials with this artificial corona, it seemed that the Savart, though very readily indicating the existence of small proportions of polarized light, did not so readily distinguish between planes of polarization at right angles to each other, as not to make me anticipate difficulty in determining whether the plane of polarization of the real corona was vertical or horizontal (supposing it to be one or the other.) This difficulty will be understood when it is remembered that while the plane moves from 0° to 45°, the appearance is radically altered, but the effect produced is the same at 0° and at 90°, save for a difference in the central band, only recognizable on careful scrutiny.

Again, when the light was radially polarized, though the appearance indicated in Fig. 2 was not well marked with feeble light, a reliable criterion of *this* condition was found even then to exist, by rotating the instrument. If the light was polarized in a plane, either vertical or horizontal, the bands disappeared at an angle of 45°, but they continued equally visible at all angles of position if the polarization was radial.

I should not mention the preparatory work with Professor Pickering without expressing my indebtedness to him for the kindness with which the results of his extensive and exact knowledge of the subject were placed at my service. Of his special familiarity with everything, pertaining to polarizing instruments in particular, I availed myself with an advantage that I take pleasure in acknowledging.

The morning of the 22d was cloudy, and gave at one time little prospect of our seeing the eclipse at all, and after the equatorial telescope was placed on its pier the rain fell so that it was necessary to cover it.

When all was ready, in the condition in which it had been arranged the day before, the equatorial was on the east of its pier, and the Savart polariscope adjusted to the finder, in the normal position described.

The small telescope was on a stand so near that any of the three instruments could be looked through without the observer's rising from his seat. Very light neutral-tint shades were used on the eye-pieces of both telescopes. The position of these instruments was the most southerly of any at the station.

As the time of first contact approached the sun was covered with a very light haze, over which thin clouds were drifting. I had intended to watch for first contact, but having no charge connected with observations of precision, on finding that Professor Young wished to watch the approach of the moon on the chromosphere, I offered to count time for him. I did so, and heard him say, "There it is!" some 12 or 15 seconds before the actual contact, which was unfortunately hidden from the spectroscope by a cloud. Returning to my own station, I awaited the approach of totality there, and was noting the irregularities of the lunar disk, about the point where second contact would take place, when clouds covered the sun altogether. No trace of polarization was

up to this time visible about the solar disk. Shortly after, rain began to fall, and the instruments were left covered, while I retired to the shelter of the tent.

I presume that all present must recall the depressing influence of the cloudy sky, which nearly hid the sun till the approach of totality. Not 15 minutes before the critical time which was so anxiously awaited, it seemed to me that the good fortune which saved us was almost beyond hope. The sky was at that time nearly uniformly dark, and even when I took my seat again, a few minutes before totality, it seemed as if there was little chance. As the moment approached, the clouds broke in the vicinity of the sun, whose thin crescent now showed through the diminishing haze. The darkness was not great; and deceived as to the remaining time by this, and by the irradiation which enlarged the crescent, I bent forward to look at my watch. Just as I turned my eyes, I heard some one call, "There's the corona!" and looking up, saw it surrounding the sun like a low-burning flame. I had intended to notice how long it was seen before totality, but I cannot give this time with precision. *After* seeing the corona, the so-called "Baily's Beads" were formed, and disappeared, the crescent breaking where the prominence on the lunar limb had before been noted, and this must have occupied at least two seconds. I turned to the larger telescope, which was directed to the eastern limb of the sun, now just covered by the moon. Under the magnifying power of 140 diameters, there appeared a uniformly diffused nebulosity.

No suspicion of structure existed, except for one feebly marked "dark ray," which was straight-edged, as a shadow projected on the misty light, and almost exactly radial. Except for this, the coronal light was uniform in the narrow field.

The base of the ray in question had a position angle of about 70° reckoned from the true vertex toward the left.

After some 30 seconds of intent but fruitless scrutiny, I turned to the polariscope. The haze at this time was very slight indeed, and at one moment the sky to the naked eye was distinctly blue.

On looking into the Savart, the field which a few minutes before was vacant of bands was now traversed by them, vertically disposed of course, (since it was still in its normal position,) but surprisingly distinct for the light, even their color being visible. They ended before reaching the edges of the field, which embraced about two degrees, and did not appear to be traceable up to the disk. I now commenced turning the little instrument; moving the notch which marked the vertex toward the right. I had tried to bring to this observation a mind free from the bias of any preconceived opinion, yet, as I am since conscious, I turned it under a certain prepossession that the polarization would prove to be in a plane either vertical or horizontal, in either of which cases the bands would vanish at an angle of 45°. When this point was reached, they were as vivid as before. I paused to assure myself of the fact, (looking at and feeling the mark on the circle,) and then slowly continued the rotation till it had been carried through 180°. In all angles the band normal to the limb was the best marked, but all the bands remained distinct enough to show color in any position. Their extent from the sun I cannot give, yet as they were not distinguished with certainty at the edges of a field 2° in diameter, I should rudely estimate this average extent at 40′. I could not, as I say, follow them up to the moon's limb, and their increasing faintness as they approached it was noticed. I did not see any bands on the moon, but my attention was directed so exclusively to verifying their persistence around it, that little weight should attach to this negative evidence. When the polariscope had been turned through a half revolution, it had rendered all the evidence to be obtained from it, but for greater security the rotation was continued through nearly 180° more. There was no other result. There were no maxima or minima of intensity corresponding to one position angle more than another.

I now turned to the smaller telescope, and placed the bar prepared in the eye-piece for that purpose, in the direction of the longest diagonal of the corona, which was roughly quadrangular in figure. I again looked at it for a few seconds with the naked eye, and without difficulty read a sentence from a printed paper lying on the table by the diffused light of the sky. The general light about me seemed much more than that of the clear sky of the eclipse of 1869.

Next, setting the larger telescope on the western side of the moon, behind which the sun was to appear, I resumed the scrutiny of the corona near the limb, without any new result till the two minutes and ten seconds of totality had ended. Other observations of less importance had been

made with the naked eye while darkness lasted; the principal results of all were written down before rising from my seat, and when I joined the other members of the party, it was with that painful feeling that precious opportunity has gone by without having been made the most of, which seems to be commonly experienced at such a time, though all may have been done one can do.

As we exchanged experiences, however, it appeared that each had something to add. How interesting the results of other observers were will be elsewhere told; on hearing them, all must have felt that we had as a party more reason to congratulate ourselves on the success achieved than to regret that it was not more absolute.

Such observations as I obtained are gathered in what follows.

NAKED-EYE OBSERVATIONS.

These, it should be said, were made incidentally to other work on which the attention was chiefly fixed. They were necessarily therefore hurried, and are doubtless a very partial presentation of the phenomena that might have been gathered if they had been the principal object.

The first appearance of the corona was at least two seconds before totality. Its outline was very irregular, the edge not so much serrated as looking like tongues of pale flame. I may compare it to the low flame of burning grass in a distant prairie fire, but the comparison is not exact as to color or motion. No color was noticed but a pearly white, and there was no certain scintillation or movement. The height of this portion of the corona was not, I think, over 5′, and it might have been much less. It was viewed in this condition only for a few seconds, and its light was so vivid that irradiation in all probability exaggerated its apparent size. A sketch taken by Mr. Gordon, of Jerez, excellently renders its form, though its dimensions there are somewhat greater than I should estimate them.

During all the time of totality, the moon's disk was lighter near the circumference than at the center. The light could be followed for perhaps one-third the radius inward. No flush of light was seen to pass over the whole disk, either at the commencement or close of totality, though this was watched for. The chromosphere was not distinguishable, except that one or two of the prominences could be seen, though they were inconspicuous. On looking at the outer edge of the corona, a second time, when the middle of totality was reached, its appearance seemed changed, probably on account of the mist, and the edge was more diffuse. Still, the average width of the readily-seen corona was at no time to my perception much over 5′, in this respect contrasting very markedly with the impression made by that of 1869. I say "of the readily-seen corona," because beyond this it might be followed perhaps, but not with confidence. I suppose the phenomena here are to some extent "sub ective," and within what limits I have tried hereafter to estimate.

DIRECT TELESCOPIC OBSERVATIONS.

The evidence from direct telescopic scrutiny is, owing to the lack of a clear sky, of chiefly negative character. The structure which has been alluded to, as seen or suspected by former observers, must be very inconspicuous, since, on the minutest examination, with adequate power, no trace of it could be found in a sky clear enough to show the phenomena already detailed. It will probably be unadvisable to give the time needful to verify or disprove its existence in any future eclipse which does not occur with wholly favorable atmospheric conditions.

The "dark ray" referred to, though very faint, was well defined and perfectly straight; it extended to the limits of the visible corona, and its width may be given, though vaguely, as probably within a minute of arc. It is probable, therefore, that it was not visible to the naked eye. The "red flames" were, of course, conspicuous, and beautiful objects in the telescope, though not more obvious or definite than when I viewed them through the C line of Professor Young's spectroscope the day before. The telescope during a total eclipse can add little to what the spectroscope now tells at any time of them, except as to their color, which the latter can only present by its components. The color, as directly seen, is to me that of the part of the spectrum midway between C and D, though some of the prominences are lighter than others, and nearer to an orange than to the "rose red," or "crimson," described by the observers of 1869. This will, perhaps, indicate that

the gas or vapor giving the bright chromosphere line D_3 all around the sun, is yet in greater relative proportions in some parts of the chromosphere than in others, or under different pressure.

The direction of the greatest extension of the corona, as seen in the small telescope, was towards the northwest, and as approximately measured by the estimated position of the field-bar, it formed an angle of very nearly 45° with the vertical.

RESULTS OF POLARISCOPIC OBSERVATION.

I do not undertake to determine whether the presence of mist about the sun should affect the inferences now drawn. If we do not consider this objection, the following conclusions naturally result from the observations already detailed.

The light of the corona is, in the ordinary use of the word, radially polarized, though not in strictly radial planes if we have regard to the large relative size of the sun.

The outer limit to which the evidence of radial polarization extends is indefinite, but is probably not less than 35′ to 40′ from its circumference. The light close to the disk is not sensibly polarized. (This is, nevertheless, it seems to me, quite consistent with the possibility of this part of the corona's sending us much reflected light.)

Considering the evidence of very marked polarization elsewhere, we may infer, I think, that the corona is visible largely, if not chiefly, through reflected sunlight, a conclusion nowise contradicted, it seems, by the evidence of self-luminosity from the spectroscope. What precedes embodies all of consequence that my notes or memory supply.

On comparing the statements of different observers a fact of interest seems to have lately given rise to question. I refer to what has been called the "subjectivity" or "personality" of the individual, which has been supposed to affect his view of phenomena seen under circumstances of such mental tension as the brevity and importance of these observations often induce. As increased attention is being paid to this question, I may be permitted to recur to what I have noticed in myself, as affording some possible aid to its elucidation.

In August, 1869, the remarkable exterior rays or streamers forced themselves on my attention, (which was directed to an observation of precision,) almost to the exclusion of everything but the work in hand. I have no distinct recollection of then noticing, what was most apparent to others, the intenser inner light, for which a distinct title (leucosphere) has since been proposed. This year, again, other work left no leisure for deliberate naked-eye observations, and what I at this time casually noticed was the complement of that seen last year. Only the light at the disk was distinctly observed by me, (and by some others,) but at the same time, one competent witness, who was close by, but, like myself, chiefly engaged in other work, described the corona as having to him the appearance of *greater* extension than that of 1869. In my own case anticipation did not color what was seen, since in neither instance did I see what was expected. Probably these observations would have been accordant, but that in each case what was seen was seen furtively, and a part of the phenomena was impressed on the memory to the exclusion of others.

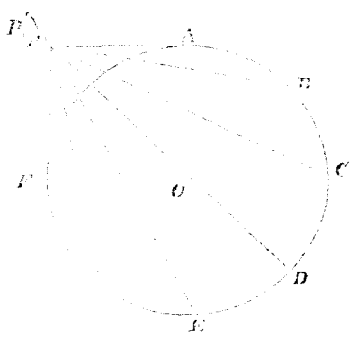
If this be, as it seems, a common experience under like conditions, to reconcile such observations with each other and the truth, it will only be necessary to apply the rule which ordinary experience teaches with regard to conflicting testimony. To do this, after eliminating as far as possible what is personal in the usual sense, such as individual deficiencies of perception as to color and so forth, we may, in discussing discrepant and presumably subjective phenomena, attach very little weight to negative testimony, but assume that what is most positive in the evidence of a conscientious observer is probably partial and incomplete rather than erroneous. If only the positive part of such testimony be collated, the rest of the so-called subjective phenomena must often cease to appear discrepant, and when superposed be complementary to, rather than contradictory of, each other.

I am, sir, very respectfully, your obedient servant,

S. P. LANGLEY.

NOTE.

Let the circle A C E F represent the disk of the sun; let P be a point in the corona at the intersection of two lines, P F, P A, tangent to the circumference at points F, A, 90° from each other, and let P be illuminated only by light from O, at the center of the disk. This light will be polarized by reflection in the plane whose trace is P D, and which (like the planes whose traces are P A, P B, P F, and so forth) passes through the eye of the observer. If an infinite number of points, illuminated only from O, as in this hypothesis, formed the corona, the appearance would be that due to strictly radial polarization.



But if P be illuminated from all points of the solar sphere which can send it light, that light will be polarized in the tangent planes P A, P F, and an infinite number between. More light may be received polarized in the plane of P D than in that of P C, and more in P C than in P B, yet it seems evident that reflected light, due to vibrations in an infinite number of planes at all azimuths, must be sensibly depolarized, at least so far as to make it much more difficult to determine the plane of maximum polarization at P than if there were but one, and that one radial. If P were at a distance, P O, in comparison with which the sun's dimension could be neglected, the polarization would again be wholly in the plane of P D. For all points, then, exterior to P the evidence of radial polarization will grow more marked; for all points nearer to O, less so.

Since similar considerations apply to every point in the corona, if its polarization be in a general sense radial, or such as would be due to directly reflected sunlight, we cannot, under the most favorable circumstances, expect evidence of it in the polariscope, from the parts very near the moon, during a total eclipse. Experience as well as theory shows that no such evidence can be found, and no conclusion against the presumption that the inner corona shines by reflected light should be drawn from its absence.

Such conclusions have been drawn, as it seems to me, erroneously, and it is therefore not superfluous to call attention to their apparent fallacy.

It is well also to remark, that if the above considerations are of any value, we are led to attach more importance to the independent evidence of the polariscope as to the extent of the corona, since evidence of polarization such as exists can only be drawn (as it here appears) from a region *outside* that to which some have believed the corona to extend.

REPORT OF OBSERVATIONS OF THE TOTAL ECLIPSE OF THE SUN OF DECEMBER 22, 1870, BY PROFESSOR EDWARD C. PICKERING, ASSISTED BY MR. WALDO O. ROSS.

BOSTON, *June* 19, 1871.

DEAR SIR: In preparing the following report on the polarization of the light of the eclipse of December 22, 1870, I have first compared some of the previous observations, then given the results of the measurement of the delicacy of different instruments, next shown what kind of polarization we should expect from theoretical considerations, then described the instruments used and the observations made with them, and finally given the conclusions to be derived and recommendations for future observations.

PREVIOUS OBSERVATIONS.

The following table shows some of the principal polariscopic observations previously made, which I have discussed more at length elsewhere, (Journal Franklin Institute, January, 1871.) The first column gives the name of the observer; the second the point of observation; the third the date; the fourth the kind of polariscope used, and the fifth the conclusion as to the intensity or existence of polarization.